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ABSTRACT

This curriculum guide, part of a plant science core curriculum, consists of materials for use in teaching a unit on fruit and vegetable production. Provided in the first part of the guide are a list of objectives, a bibliography, and a competency profile. The remainder of the guide consists of 11 lessons dealing with the following topics: planning and planting a garden and orchard; growing vegetable transplants; growing tomatoes, peppers, and eggplants; raising beans, peas, and sweet corn; cultivating cole crops and cucurbits; growing apples and peaches; raising strawberries, blueberries, raspberries, and blackberries; caring for vineyards; and marketing fruits and vegetables. Included in each lesson are some or all of the following: a lesson objective; study questions; a list of references and handouts; a detailed teaching outline that includes motivation techniques, discussion questions, other suggested activities, a competency statement, an evaluation activity, and answers to the evaluation activity; and transparency masters. (MN)

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INSTRUCTOR'S GUIDE

# FRUIT AND VEGETABLE PRODUCTION UNIT
# FOR
# PLANT SCIENCE CORE CURRICULUM

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## ACKNOWLEDGMENTS

The Fruit and Vegetable Production unit for Plant Science represents a new addition to the current materials. The unit was suggested by the MVATA Teaching Aids Committee.

The format of these lessons should aid teachers in their lesson planning. The entire unit has been reproduced in its entirety so that it may be inserted into the Plant Science book.

Special recognition is due to the horticulture curriculum advisory committee who provided numerous suggestions for improvement which were incorporated into this unit.

Special recognition is also due to Dr. Harley Schlichting, Director of the Instructional Materials Laboratory, and his staff for the typing, editing, and illustrating of this unit.

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Instructional Materials Laboratory

Bob R. Stewart
Professor
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# FOREWORD

The Fruit and Vegetable Production unit for Plant Science has been developed and reproduced in its entirety. The unit was suggested by the MVATA Teaching Aids Committee. All lessons have been organized in a format to aid teachers in planning their lessons. This unit is to be taught as a part of the second year of instruction for students of vocational agriculture.

This unit consists of eleven lessons designed to help the students--Lesson 1 on planning and planting gardens and orchards, Lesson 2 on growing vegetable transplants, Lesson 3 on growing warm season solanaceous crops, Lesson 4 on raising beans, peas, and sweet corn, Lesson 5 on growing cole crops and cucurbits, Lesson 6 on growing apples and peaches, Lesson 7 on raising strawberries, Lesson 8 on growing raspberries and blackberries, Lesson 9 on cultivating blueberries, Lesson 10 on cultivating grapes and vineyards, and Lesson 11 on marketing fresh fruits and vegetables.

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# FRUIT AND VEGETABLE PRODUCTION UNIT
# FOR
# PLANT SCIENCE CORE CURRICULUM

## TABLE OF CONTENTS

ACKNOWLEDGMENTS

FOREWORD

OBJECTIVES

BIBLIOGRAPHY

COMPETENCY PROFILE

UNIT - FRUIT AND VEGETABLE PRODUCTION

**Lesson 1 - Planning and Planting the Garden and Orchard**

TM-1/HO-1: Vegetable Planting and Harvest Guide
TM-2/HO-2: Garden Plan
TM-3/HO-3: Average Frost Free Dates
TM-4/HO-4: Mulching Materials
TM-5/HO-5: Orchard Layout-Stake Method
TM-6/HO-6: Comparison of Orchard Planting Systems

**Lesson 2 - Growing Vegetable Transplants**

TM-7/HO-7: Coldframe Design
TM-8/HO-8: Lifting Dicot Seedlings

**Lesson 3 - Warm Season Solanaceous Crops: Tomatoes, Peppers, and Eggplants**

TM-9/HO-9: Pruning Tomatoes

**Lesson 4 - Beans, Peas, and Sweet Corn**

**Lesson 5 - Cole Crops and Cucurbits**

TM-10/HO-10: The Twelve-spotted and Striped Cucumber Beetles

**Lesson 6 - Growing Apples and Peaches**

TM-11/HO-11: Air Drainage and Frost Pockets
TM-12/HO-12: Apple Variety Bloom Period Chart
TM-13/HO-13: Grafted and Interstem Apple Trees
TM-14/HO-14: Rootstock Height Comparison
TM-15/HO-15: Planting Distances for Apple Trees
TM-16/HO-16: Planting Plans to Provide for Cross-Pollination

TM-17/HO-17: Fruit Tree Pruning Terminology
TM-18/HO-18: Pruning Newly Set Apple Trees
TM-19/HO-19: The Central Leader Pruning System for Apples
TM-20/HO-20: Pruning Mature Peach Trees

Lesson 7 - Strawberries

TM-21/HO-21: Strawberry Planting Depths

Lesson 8 - Brambles: Raspberries and Blackberries

TM-22/HO-22: Pruning Bramble Fruits

Lesson 9 - Blueberries

TM-23/HO-23: Pruning Blueberry Plants

Lesson 10 - Grapes and Vineyards

TM-24/HO-24: Trellis Systems for Grapes
TM-25/HO-25: Pruning Young and Mature Grapevines

Lesson 11 - Marketing Fresh Fruits and Vegetables

PLANT SCIENCE CORE CURRICULUM

Unit - Fruit and Vegetable Production

LESSONS

1. Planning and Planting the Garden and Orchard
2. Growing Vegetable Transplants
3. Warm Season Solanaceous Crops; Tomatoes, Peppers, and Eggplants
4. Beans, Peas and Sweet Corn
5. Cole Crops and Cucurbits
6. Growing Apples and Peaches
7. Strawberries
8. Brambles: Raspberries and Blackberries
9. Blueberries
10. Grapes and Vineyards
11. Marketing Fruits and Vegetables

OBJECTIVES

1. Given a written examination, the student will be able to identify basic principles of planning and planting fruit and vegetable crops, with 75% accuracy.*
2. Given a written examination, the student will be able to analyze basic principles of vegetable crop transplant production with 75% accuracy.
3. Given a written examination, the student will be able to identify characteristics and production practices for warm season solanaceous crops with 75% accuracy.
4. Given a written examination, the student will be able to identify basic characteristics and techniques for growing beans, peas, and corn, with 75% accuracy.
5. Given a written examination, the student will be able to identify the basic characteristics for growing cole crops and cucurbits with 75% accuracy.
6. Given a written examination, the student will be able to identify principles and techniques for cultivating apples and peaches with 75% accuracy.

7. Given a written examination, the student will be able to identify characteristics of and techniques for producing strawberries with 75% accuracy.

8. Given a written examination, the student will be able to identify characteristics of and techniques for growing bramble plants with 75% accuracy.

9. Given a written examination, the student will be able to identify characteristics of and techniques for cultivating highbush and rabbiteye blueberries with 75% accuracy.

10. Given a written examination, the student will identify characteristics of and basic techniques for growing grapes with 75% accuracy.

11. Given a written examination, the student will identify approaches and ideas for the direct marketing of fresh fruits and vegetables with 75% accuracy.

*NOTE: Percent accuracy is to be set by instructors to reflect passing grade in their school systems.

COMPETENCIES TO BE DEVELOPED

1. Identify basic principles of planning and planting fruit and vegetable crops.

2. Analyze basic principles of vegetable crop transplant production.

3. Identify characteristics and production practices for warm season solanaceous crops.

4. Identify basic characteristics and techniques for growing beans, peas, and sweet corn.

5. Identify the basic characteristics of and techniques for growing cole crops and cucurbits.

6. Identify principles and techniques for cultivating apples and peaches.

7. Identify characteristics of and techniques for producing strawberries.

8. Identify characteristics of and techniques for growing selected bramble fruits.

9. Identify characteristics of and techniques for cultivating highbush and rabbit-eye blueberries.

10. Identify characteristics of and basic techniques for growing grapes.

11. Identify approaches and ideas for the direct marketing of fresh fruits and vegetables.

MOTIVATIONAL TECHNIQUES OR INTEREST APPROACH:

1. Ask students if they already produce fruit or vegetable crops.
2. Discuss the potential of producing fruit or vegetable crops in regard to agricultural enterprises and student SOEP's.
3. Point out that fruit and vegetable crops are an important and necessary component of our diets.
4. Discuss the dramatic increase in popularity of fresh, locally grown fruits and vegetables.
5. Describe successful fruit and vegetable operations in your area.

GETTING READY FOR THIS UNIT

A. References and Materials:

The references and materials listed below are only suggestions. This does not imply that they must all be used. Using any of the suggested texts and a selection of the other materials should be sufficient to successfully teach the unit.

1. Fruit and Vegetable Crop Production Unit - Student Reference for Plant Science Core Curriculum.
2. Gardening for Food and Fun. U.S.D.A. Yearbook of Agriculture, 1977.
3. Missouri Cooperative Extension Service Guides:
   - a) G96135: Strawberries for Home Fruit Production
   - b) G96160: Establishing a Vineyard in Missouri
   - c) G06161: Pruning and Training Grapevines
   - d) G06162: Training Systems for Missouri Vineyards
   - e) G00260: Starting a Successful Farmers' Retail Market
   - f) G06201: Vegetable Planting Calendar

   Available to Missouri residents at University of Missouri-Lincoln University Extension Centers in each county, or from

   Extension Publications
   222 South 5th Street
   University of Missouri
   Columbia, MO 65211
4. Manual 75: Missouri Farm Planning Handbook - Available from Extension Centers or Instructional Materials Lab. (Addresses for both are listed herein.)

5. Filmstrips and slide sets

   a) Pruning Deciduous Fruit Trees
   b) Vegetable Gardening
   c) Vegetable Identification

   PhotoCom Productions
   P.O. Box 3135, 1
   Pismo Beach, CA 93449

   d) Vegetable Identification Slide Set
   e) Grape Vineyard Establishment and Maintenance

   Vocational Educational Productions
   California Polytechnic State University
   San Luis Obispo, CA 93407

6. Handouts and Transparencies for this Fruit and Vegetable Production Guide are available from the Instructional Materials Laboratory, 10 Industrial Education Building, University of Missouri-Columbia, Columbia, MO 65211.

## EVALUATION

1. Give short objective tests at the end of each lesson or at the end of the unit.

2. Observe the changes in behavior as evidence of an improved ability of the students to deal with problems in this unit using background acquired from earlier units.

3. Observe students' attempts to solve similar problems in their supervised occupational experience programs.

# Fruit and Vegetable Production
## Major Competency Profile

**Directions:** Evaluate the student by checking the appropriate number or letter to indicate the degree of competency. The rating for each task should reflect **employability readiness** rather than the grades given in class.

**Rating Scale:**
3 **SKILLED** - can work independently with no supervision
2 **MODERATELY SKILLED** - can perform job completely with limited supervision
1 **LIMITED SKILL** - requires instruction and close supervision
N **NO EXPOSURE** - no experience or skill in this area

| 3 | 2 | 1 | N | |
|---|---|---|---|---|
| | | | | **Fruit and Vegetable Production** |
| | | | | 1. Identify principles of planning and planting fruits and vegetables |
| | | | | 2. Analyze vegetable transplant production |
| | | | | 3. Identify techniques for growing warm season solanaceous crops |
| | | | | 4. Identify techniques for growing beans, peas, and sweet corn |
| | | | | 5. Identify techniques for growing cole crops and cucurbits |
| | | | | 6. Identify principles for cultivating apples and peaches |
| | | | | 7. Identify techniques for producing strawberries |
| | | | | 8. Identify techniques for raising brambles |
| | | | | 9. Identify techniques for cultivating blueberries |
| | | | | 10. Identify techniques for growing grapes |
| | | | | 11. Identify approaches for the direct marketing of fresh fruits and vegetables |

# Fruit and Vegetable Production

Class/Section: ____________

| STUDENTS: | Identify Principles of Planning and Planting Fruits and Vegetables | Analyze Vegetable Transplant Production | Identify Techniques for Growing Warm Season Solanceous Crops | Identify Techniques for Growing Beans, Peas, and Sweet Corn | Identify Techniques for Growing Cole Crops and Cucurbits | Identify Principles for Cultivating Apples and Peaches | Identify Techniques for Producing Strawberries | Identify Techniques for Raising Brambles | Identify Techniques for Cultivating Blueberries | Identify Techniques for Growing Grapes | Identify Approaches for Direct Marketing of Fresh Fruits and Vegetables |
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## UNIT - FRUIT AND VEGETABLE PRODUCTION

### Lesson 1: Planning and Planting the Garden and Orchard

Objective: The student will be able to identify basic principles of planning for production, and planting of fruit and vegetable crops.

Study Questions:

1. Why is it a good idea to make a planting plan for the garden and orchard?
2. What are some practices for preparing garden and orchard soils for planting?
3. What is a starter solution? How and why is it used?
4. Describe proper techniques for row planting and hill planting of vegetable seed.
5. Discuss proper techniques for setting out transplants.
6. Differentiate between warm and cool season crops in regard to plant growth.
7. What is mulch and how is it used in a vegetable garden or fruit patch?
8. Why would you utilize a particular planting system in your orchard?

References:

1. Student Reference
2. Gardening for Food and Fun: USDA Yearbook of Agriculture, 1977, pp. 119-125.
3. Missouri Cooperative Extension Agricultural Guide G06201: Vegetable Planting Calendar
4. Handouts
   a) HO-1: Vegetable Planting and Harvest Guide
   b) HO-2: Garden Plan
   c) HO-3: Average Frost Free Date
   d) HO-4: Mulching Materials
   e) HO-5: Orchard Layout-stake Method
   f) HO-6: Comparison of Orchard Planting Systems

5. Transparency Masters

a) TM-1: Vegetable Planting and Harvesting Guide
b) TM-2: Garden Plan
c) TM-3: Average Frost Free Dates
d) TM-4: Mulching Materials
e) TM-5: Orchard Layout-Stake Method
f) TM-6: Orchard Planting Systems

UNIT - FRUIT AND VEGETABLE PRODUCTION

Lesson 1: Planning and Planting the Garden and Orchard

TEACHING PROCEDURES

A. Introduce unit.

B. Motivation

There is no substitute for planning. Profitable vegetable and fruit crop production depends on good planning. As with everything else, many pitfalls and troubles can be avoided with just a little foresight. Planning can mean the difference between success and failure.

C. Assignment

D. Supervised Study

E. Discussion

1. Ask the students to discuss the merits of garden and orchard planning. Discuss the different types of crops that can be grown in a diversified operation. List all the reasons students think of on the board. (Show TM-1 and TM-2 and analyze the garden plan.) (Discuss UM Extension Guide G06201.)

   **Why is it a good idea to make a planting plan for the garden and orchard?**

   1) Calculate nursery stock needs.
   2) Inventory and record of planting
   3) Irrigation planning
   4) Planning roads, waterways, etc.
   5) Cultivar section - pollinator placement
   6) Plan planting system.
   7) Plan which vegetable types to grow.
   8) Estimate how much to grow - yield calculations.
   9) Plan space utilization and sketch out the proposed garden.
      a) Location - group by type and time of maturity, avoid shading
      b) Amount - row length
      c) Time to plant - rotations

2. Discuss soil preparation practices with the students. Emphasize why these are done. Let the students give their ideas. List these practices on the board.

   **What are some practices for preparing garden and orchard soils for planting?**

   1) Soil preparation is of utmost importance, especially for orchard crops, because trees are so long lived and represent a substantial investment.
   2) Prepare at least one year in advance.

3) Green manure - to add organic matter
4) Soil test - bring fertility up to acceptable levels
5) Construct terraces and waterways.
6) Subsoiling
7) Soil pH should be adjusted for crop to be grown.
8) Plow garden and orchard sites eight inches deep, do not work soil when wet.

3. Describe the use and need for starter solutions with vegetable crops. An experiment could be planned comparing a plant watered with starter solution and one without starter solution.

**What is a starter solution? How and why is it used?**

1) Weak solution of fertilizer (mixed with water)
2) For use at transplanting
    a) A small amount put around roots of transplant
    b) Provides readily available nutrients
    c) Reduces transplant mortality
    d) Promotes early and rapid growth
    e) Improves yield

4. Let students discuss how they plant vegetable seed. Steer them toward and identify desirable techniques for hill and row planting. Discuss why some crops are hill planted and why some are row planted.

**Describe proper techniques for row planting and hill planting of vegetable seed.**

1) Row plantings for most vegetables
    a) Row should be straight; use a string.
    b) Hand fertilize along string.
    c) Make shallow furrow.
    d) Sow seed uniformly and not too thick. (Thin seedlings if too thick.)
    e) Cover seed with fine soil, not clods, and firm. Establish good seed-soil contact for proper germination
    f) Plant fairly shallow; 1/2 to 1 inch deep depending on seed size.
        (1) Large seeds deeper than small seeds
        (2) Rule of thumb - plant seeds at depth 2 to 4 times the width of seed
    g) Distance between rows
        (1) Cultivation
        (2) Plant size
2) Hill planting for cucurbits (vine crops)
    a) Prepare hill by mounding soil.
    b) Hills are a few feet apart.
    c) Several seeds are sown on each hill and then thinned (after seedlings emerge) to two or three seedlings per hill.

5. Discuss with students the desirable techniques for handling and setting out transplants. It would be desirable to have a small demonstration of accepted procedures. List the crops that might be transplanted.

   Discuss proper techniques for setting out transplants.

   1) Setting out transplants provides for early maturation of crop.
   2) Techniques
      a) Keep roots and soil intact to lessen transplanting shock.
      b) Remove plants from bed and plant immediately.
      c) Open holes with trowel at desired intervals.
      d) Set transplants deeper than dug from bed.
      e) Fill soil around roots and firm slightly.
         (1) Good root-to-soil contact essential for root survival.
         (2) Air pockets will cause roots to dry out and die
      f) Water in with starter solution and then rake dry soil around depression
      g) Wrap stems to discourage cutworms.

6. Ask the students to discuss the differences between warm and cool season crops. List crops on the board according to these two categories. (Use TM-3)

   Differentiate between warm and cool season crops in regard to plant growth.

   1) Warm season crops require warm weather.
      a) Germination, growth and development
      b) Killed by freezing temperatures
      c) Plant after danger of frost is past. (See TM-6.)
   2) Cool season crops grow best in relatively cool weather.
      a) Tolerate slightly freezing temperatures
      b) Plant two to four weeks before last spring frost or in summer for fall crop. (Will grow well past first killing frost of fall.)

7. Let students describe mulching materials they have used and the results of their use. List the effects of mulching on the board. Also list the different materials that can be used for mulches. (Use TM-4.)

   What is mulch and how is it used in a vegetable garden or fruit patch?

   1) Surface mulching is the placement of a mat of material around the base of a plant to control weeds, regulate soil temperature, conserve moisture, prevent runoff and erosion, protect overwintering plants, and improve soil structure.
   2) Types of mulching materials
      a) Organic: straw, grass clippings, wood chips and shavings, spoiled hay, leaves, etc. (See TM-4.)

    - (1) Wait until soil has warmed up well. (Early mulching delays maturity.)
    - (2) Cultivate to control weeds before mulching.
    - (3) Mulch only after seeds have germinated and have achieved several inches of growth.
    - (4) Spread 2 to 4 inches deep.
    - (5) Add nitrogen source.
  - b) Inorganic - aluminum foil, black plastic, etc.
    - (1) Place unrolled plastic over prepared soil along rows.
    - (2) Other types placed similarly
    - (3) Place in early spring as plastic mulches tend to warm soil.
  - c) General crop responses to mulching
    - (1) Increase in total production
    - (2) Improvement in quality of harvested products
    - (3) Delay in maturing of annual vegetables
    - (4) Depletion of soil nitrogen available immediately after mulching (add nitrogen to prevent this)

8. Have students describe the various orchard planting systems. Ask them to discuss the merits and disadvantages of each system in their particular situation. Illustrate these particular systems. When designing an orchard layout, it is wise to consider existing equipment sizes (tractors, wagon, etc.). (Use TM-5 and TM-6.)

   Discuss why you would utilize a particular planting system in your orchard.

   - 1) There are several systems used and new ones are developed from time to time.
     - a) square
     - b) rectangular
     - c) quincunx
     - d) triangle or hexagonal
     - e) hedgerow
     - f) trellis
   - 2) All have definite applications so there is no right or wrong answer, but students should develop a rationale for their use of a system.

F. Other Activities

1. Visit an orchard, fruit farm or vegetable farm to observe spring planting techniques and to see different planting schemes.

2. Plan laboratory period to set out fruit and vegetable plants and seeds.

G. Competency

Identify basic principles of planning and planting fruit and vegetable crops.

## H. Answers to Evaluation

1. b
2. d
3. b
4. 1/2 - 1 inch or 2 - 4 times the width of the seed
5. Disturb roots as little as possible and water in
6. To keep roots from drying out and dying
7. c

8 *a. weed control
   b. moisture conservation
   *other answers may be accepted

UNIT - FRUIT AND VEGETABLE PRODUCTION

Lesson 1: Planning and Planting the Garden and Orchard

## EVALUATION

1. Which is not a reason for making planting plans?

   a. provides an inventory
   b. gives you something to do during winter months
   c. for planning irrigation
   d. consider space utilization

2. Preparing soil for planting includes which of the following?

   a. soil fertility testing
   b. plowing
   c. addition of green manure
   d. all of the above

3. Starter solutions

   a. are not used for vegetable transplants
   b. are weak fertilizer solutions
   c. are weak insecticide solutions
   d. are applied just before transplanting

4. How deep should vegetable seeds be planted?

5. What is the best way to minimize transplant shock?

6. Why is it important to make sure roots are in good contact with the soil when setting out plants?

7. When setting out plants and trees

   a. planting depth makes little difference
   b. watering in is a good idea but not really necessary
   c. holes should comfortably accommodate roots
   d. all of the above

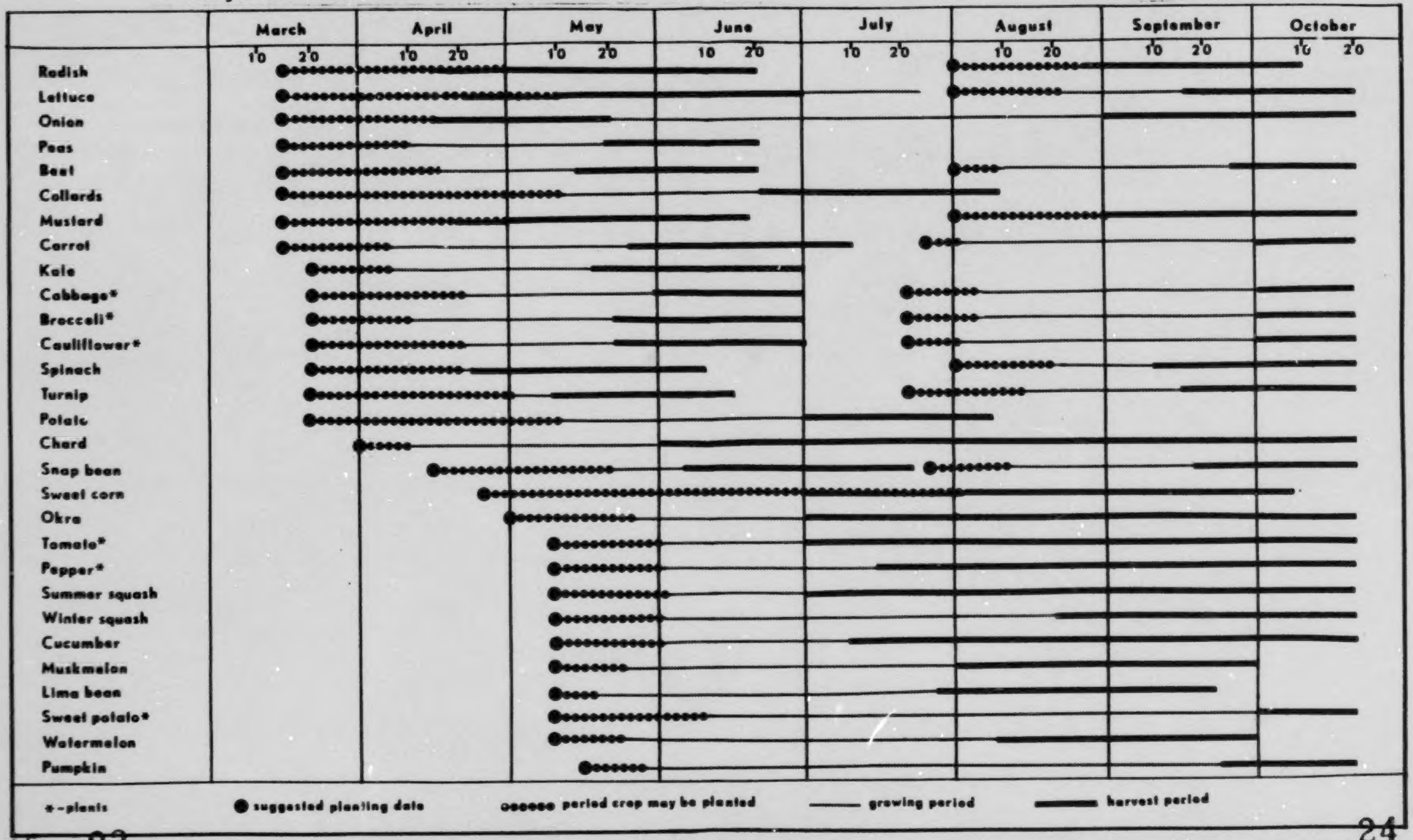
8. What are two main purposes of mulches?

   a.

   b.

# Vegetable Planting and Harvesting Guide

This chart lists the proper planting and harvesting dates for mid-Missouri. For most vegetables, gardeners in the bootheel should subtract about ten days from the spring planting dates given. Gardeners in northern Missouri should add about seven days. The dates listed are averages - yearly adjustments can be made.



TM-2

# Garden Plan

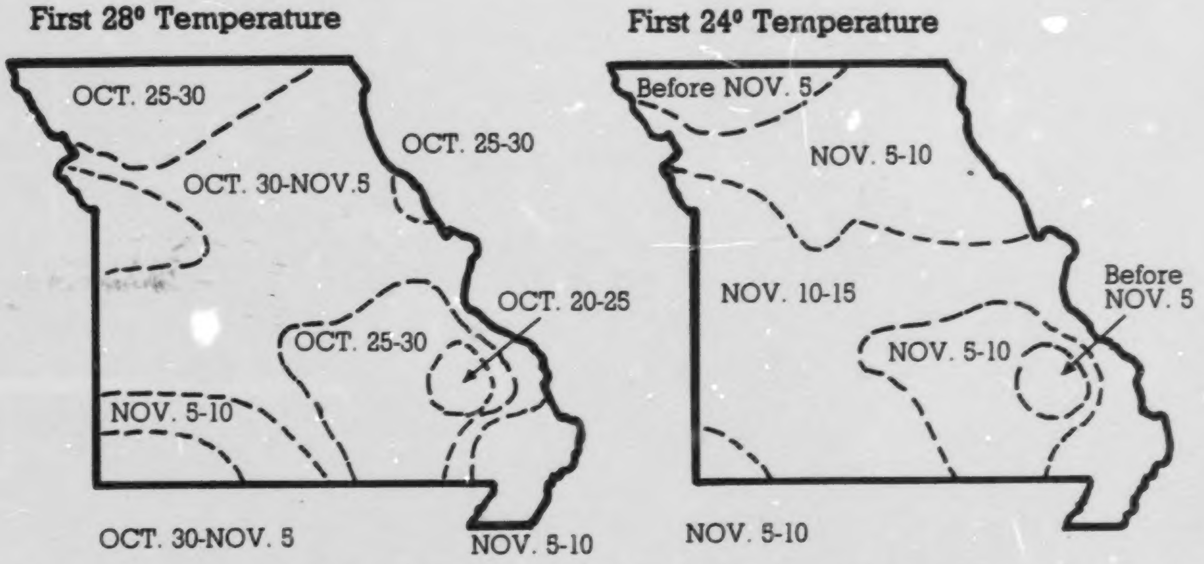
| 8 ft. | 7 ft. | 10 ft. |
|---|---|---|
| green onion$^1$-bibb$^4$ | herbs (April 1) | |
| endive$^1$-bibb$^4$ | spinach$^1$-radish$^2$-lettuce$^3$ | carrot$^1$-beets$^3$ |
| leaf lettuce$^1$-bibb$^4$ | kale$^1$-beets$^2$ | radish$^1$-lettuce$^2$-kale$^3$ |
| sweetcorn (April 15) | early potatoes (March 15) | |
| sweetcorn (July 15) | spinach (Sept. 1) | |
| sweetcorn (April 15) | peas (March 15) | |
| sweetcorn (July 15) | sweet potatoes (June 1) | |
| sweetcorn (April 15) | early cabbage (March 15) | cauliflower (April 1) |
| sweetcorn (July 15) | bush beans (June 15) | |
| sweetcorn (May 15) | early broccoli (April 1) | |
| cabbage (Aug. 15) | summer squash (June 15) | okra (June 15) |
| sweetcorn (May 15) | storage onions (April 1) | |
| cauliflower (Aug. 15) | Brussels sprouts (Aug. 15) | |
| sweetcorn (May 15) | bush beans (May 7) | |
| mustard greens (Aug. 15) | summer squash (July 15) | cabbage (July 15) |
| sweetcorn (June 15) | bush lima beans (May 7) | |
| broccoli (Sept. 1) | bush beans (Aug. 1) | |
| sweetcorn (June 15) | tomato (May 7) | pepper (May 15) |
| broccoli (Sept. 1) | | |
| sweetcorn (June 15) | pickle cucumber (May 15) | slicer cucumber (May 15) |
| broccoli (Sept. 1)<br>late cabbage (Mar. 15) | carrots (Aug. 1) | |
| sweetcorn (July 1) | eggplant (May 15) | summer squash (May 15) |
| turnip (Sept. 15)<br>late broccoli (April 1) | endive (Sept. 1) | beets (July 1) |
| sweetcorn (July 1) | late potatoes (June 1) | |
| turnip (Sept. 15)<br>swiss chard (April 1) | | |
| sweetcorn (July 1) | late potatoes (June 1) | |
| turnip greens (Sept. 15) | | |

| | | |
|---|---|---|
| asparagus bed (2 rows) | rhubarb | horseradish |

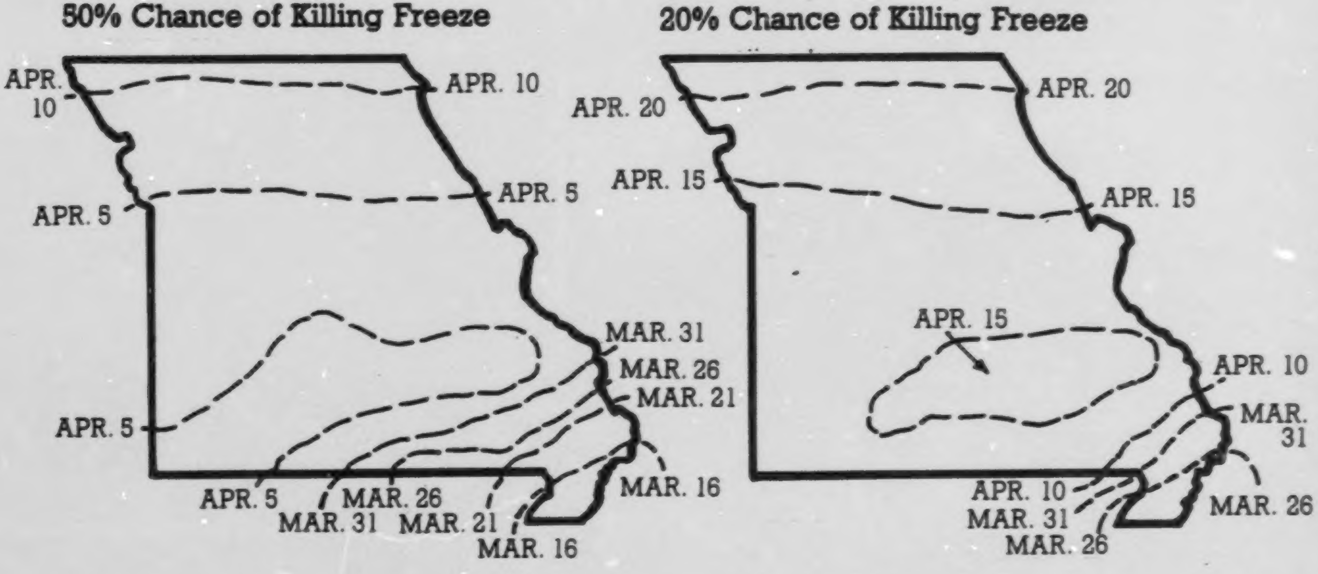
CODE:
1 - *first planting (March 15)*
2 - *second planting (June 15)*
3 - *third planting (Aug. 15)*
4 - *fourth planting (Sept. 15)*

(40' x 25' = 1,000 sq. ft.) (2½ feet between rows)

# Average Frost Free Dates


First 28° Temperature
OCT. 25-30
OCT. 25-30
OCT. 30-NOV.5
OCT. 20-25
OCT. 25-30
NOV. 5-10
OCT. 30-NOV. 5
NOV. 5-10
First 24° Temperature
Before NOV. 5
NOV. 5-10
NOV. 10-15
Before NOV. 5
NOV. 5-10
NOV. 5-10

Average dates of first frosts - light frosts (32°) cause little plant damage, while moderate frosts (24°) usually kill all annual plants.


50% Chance of Killing Freeze
APR. 10
APR. 10
APR. 5
APR. 5
MAR. 31
MAR. 26
MAR. 21
APR. 5
MAR. 16
APR. 5
MAR. 26
MAR. 31
MAR. 21
MAR. 16
20% Chance of Killing Freeze
APR. 20
APR. 20
APR. 15
APR. 15
APR. 15
APR. 10
MAR. 31
APR. 10
MAR. 31
MAR. 26
MAR. 26

Spring date probabilities for moderate killing freezes (24°-28°).

# Mulching Materials

## Coarse Mulches

1. Straw
2. Hay
3. Weeds
4. Wood shavings
5. Seaweeds
6. Corn stover

## Medium-coarse Mulches

1. Leaves
2. Chopped corncobs
3. Peat moss

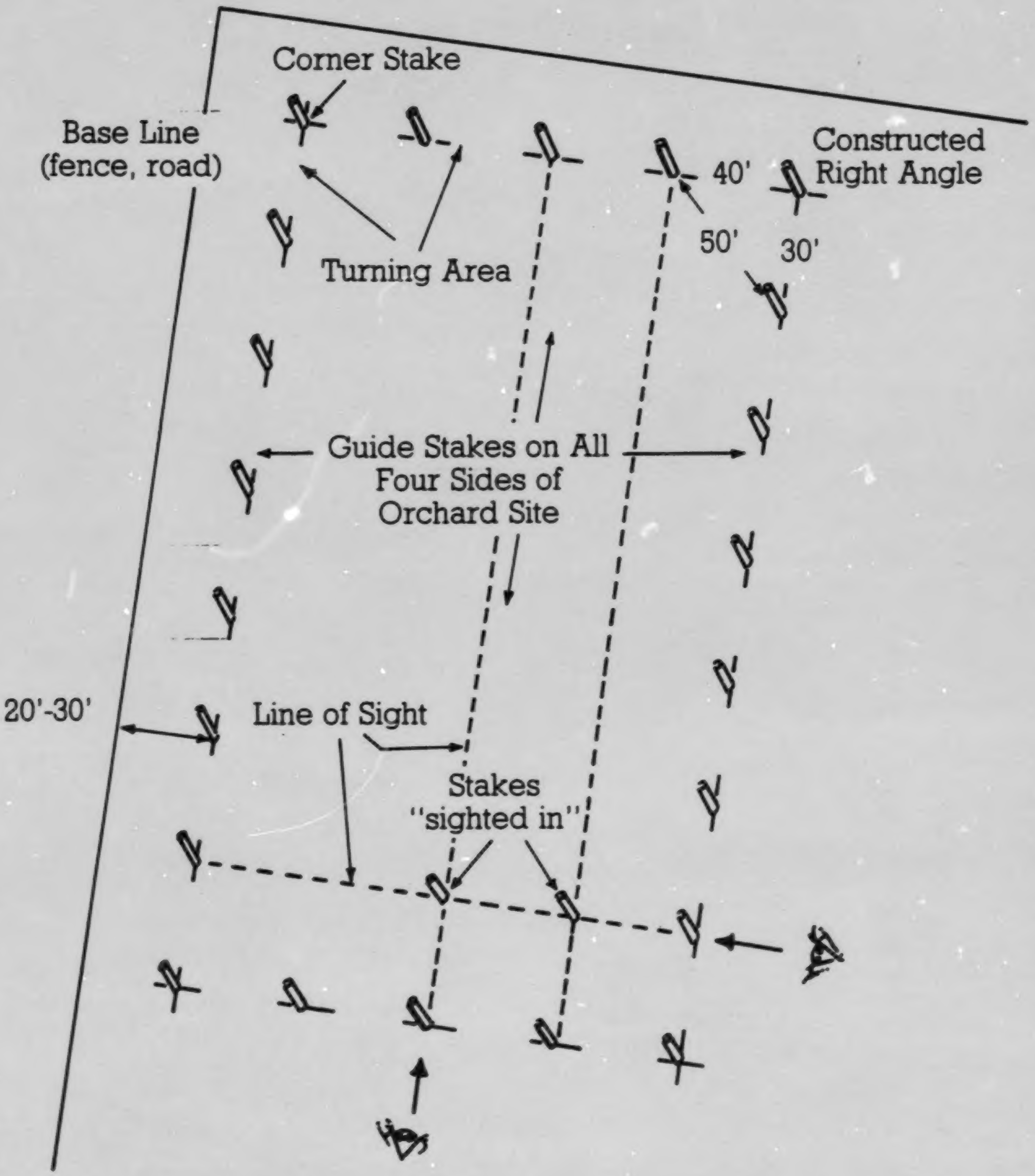
## Fine Mulches

1. Sawdust
2. Manures
3. Lawn clippings
4. Cottonseed hulls
5. Rice hulls
6. Packing-house refuse (apple pomace, etc.)

## Artificial Mulches

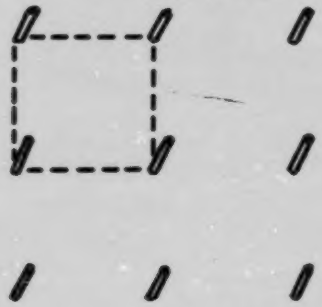
1. Glass wool
2. Paper
3. Charcoal
4. Aluminum foil
5. Black plastic

# Orchard Layout - Stake Method


Corner Stake
Base Line
(fence, road)
Constructed
Right Angle
40'
50'
30'
Turning Area
Guide Stakes on All
Four Sides of
Orchard Site
20'-30'
Line of Sight
Stakes
"sighted in"

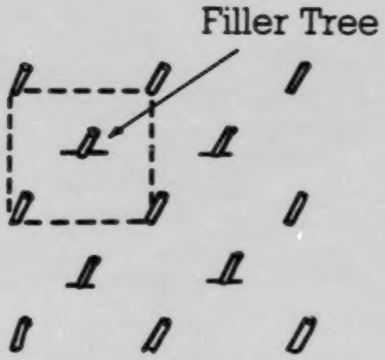
# Comparison of Orchard Planting Systems

**SQUARE**



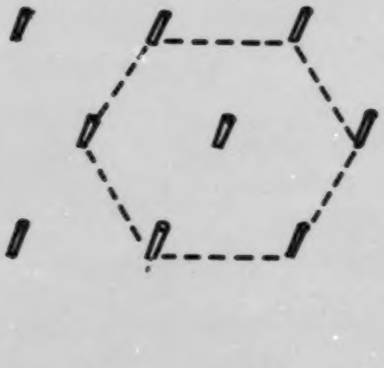
1. A common system used
2. Easy installation
3. Easy manipulation of orchard equipment

**QUINCUNX**



1. Modification of square
2. Filler tree planted in center of square
    a. Purpose - to obtain greater yields and income while orchard is young
    b. Early bearing varieties used
    c. Permanent tree planted on square and filler in center
3. More difficult to carry out cultural operations
4. Filler trees to be removed later
5. Twice as many trees as square system

**HEXAGONAL**



1. 15% more trees per acre than square
2. Cultivation in three directions possible
3. Planting triangle necessary for layout, use planting board and wire
4. Trees equidistant from neighboring trees

UNIT - FRUIT AND VEGETABLE PRODUCTION

Lesson 2: Growing Vegetable Transplants

Objective: The student will be able to produce vegetable crop transplants using techniques involving containers, growing media, seed sowing, water relations and hardening off.

Study Questions

1. Describe the characteristics of the ideal vegetable transplant.
2. Discuss various structures for producing vegetable transplants.
3. Describe some of the different containers for growing seedlings and discuss why they are used.
4. What is a growing medium?
5. Describe the steps of seed sowing and list desirable temperatures for seed germination and seedling growth for warm and cool season crops.
6. Describe the steps in the process of "spotting" out seedlings.
7. What are some rules for watering vegetable seedlings?
8. Describe the purpose and process of "hardening off" vegetable transplants.
9. What is damping off and how can it be controlled?

References:

1. Student Reference
2. Gardening for Food and Fun: USDA Yearbook of Agriculture 1977. pp. 111-118.
3. Handouts
    a) HO-7: Coldframe Design
    b) HO-8: Lifting Dicot Seedlings
4. Transparency Masters
    a) TM-7: Coldframe Design
    b) TM-8: Lifting Dicot Seedlings

UNIT - FRUIT AND VEGETABLE PRODUCTION

Lesson 2: Growing Vegetable Transplants

TEACHING PROCEDURES

A. Review previous lesson.

B. Motivation

Growing healthy transplants is the first step to producing a good crop of vegetables. Starting your own transplants can help you make greater profits by saving initial cash outlay for commercial transplants and by enabling you to get a jump on the growing season.

C. Assignment

D. Supervised Study

E. Discussion

1. Ask the students to tell you what a transplant is and why transplants are preferable to direct sowing. Have the students describe desirable and undesirable characteristics of transplants.

   Describe the characteristics of the ideal vegetable transplant.

   1) Transplants are seedlings that are started in protective and controlled environments to be later set out in the garden.
   2) Desirable characteristics include:
      a) Stocky, sturdy stems, not spindly and elongated
      b) Good color - dark rich green, not pale or yellowed
      c) Disease free
      d) At proper stage for growth when set out; (sufficiently mature to withstand outside environment)

2. Have students describe various structures designed for controlling seedling environment. Discuss advantages of each. (Use TM-7.)

   Discuss various structures for producing vegetable crop transplants.

   1) Greenhouse - best because it is equipped with automatic controls for environmental control
      a) Commercial kits are available or you can build one from scratch.
      b) Easy to work in
   2) Cold frame
      a) Frame sunk in ground with glass sash for roof, bottom layer of sand
      b) Inexpensive - can be made from surplus or scrap materials
   3) Hot bed - same as cold frame but with heating element in sand

        a) Warms germinating seeds and seedling roots
        b) Both cold frame and hotbed are good, economical structures; many plans for building them are available. (Refer to TM-7.)
    4) In your house - this is the most difficult location
        a) Large south or southwest facing window for sunlight, or cool white fluorescent supplemental lights
        b) Keep lights on 12 to 16 hours per day.
        c) Temperature control
            (1) Day - 75-80°F
            (2) Night - 55-60°F - (high night temperatures result in tall, soft, spindly plants)

3. List some of the warm and cool season garden crops; tell which ones are transplanted with bare roots or with the root ball intact. Discuss why seedlings benefit from planting with the root ball intact. Show some of the different containers available for seedling production and have students relate their experiences with them. Discuss some of the advantages and disadvantages of the different types of containers and planting techniques.

**Describe some of the different containers for growing seedlings and discuss why they are used.**

1) Seedlings grown in plantable containers benefit because their roots are not injured or killed when transplanting. Because the seelding is not as drastically shocked by being transplanted into a new environment, it will be able to more readily adapt and grow better.
2) Types of containers include:
    a) Compressed peat pellets
    b) Peat pots
    c) Plastic pots (can't be put in ground with transplant)
    d) Fiber blocks
3) Planting techniques
    a) Choose larger size single plant containers.
    b) Don't crowd multi-plant containers.
    c) Completely bury peat pots.
    d) Remove plants from plastic pots.
    e) Break apart extensive root systems.
    f) Make sure there is good root-to-soil contact when planting.

4. Ask students to define growing medium and let them describe different media they have used. List the desirable properties of growing media. Show them several different types and possibly have the individual components available for inspection. Discuss the function of these components within the medium.

**What is a growing medium?**

1) The material a plant grows in is a growing medium; it should have these characteristics:
    a) Good water drainage

   - b) Adequate water-holding capacity
   - c) Free of harmful substances
   - d) Reasonable cost and readily available
   - e) Free of weed seeds, insects, and diseases

2) There are many different types of growing media; the newest types are soilless. Components of plant growing media include
   - a) Soil
   - b) Peat moss
   - c) Sand
   - d) Vermiculite
   - e) Perlite
   - f) Nutrients

3) Media for seed germination should be fine-textured and well-drained.
   - a) Do not contaminate.

4) Will probably need to fertilize developing seedlings

5. Have students list the proper techniques of seed sowing step by step. List these on the board. Discuss temperature in regard to seed germination and seedling development. Also, discuss variety selection at this time.

   **Describe the steps of seed sowing, and list desirable temperatures for seed germination and seedling growth for warm and cool season crops.**

   1) Before planting seed, water medium thoroughly and allow it to drain for several hours.
   2) Sow in rows.
      - a) Press 1/2-inch wide board into media to make a flat bottom trench.
      - b) Distribute seed in the trench - 8 to 10 plants per inch of row.
      - c) Cover seeds with about 1/2-inch of growing medium.
   3) Warm season cucurbit seed can be sown individually and directly into containers that will be set in the garden.
   4) Check medium daily and lightly water if needed.
   5) Temperatures
      - a) Germination 60-80°F (except warm season vine crops which should be germinated at 80-90°F)
      - b) After germination - lower temperature after seedling emergence
        - (1) Warm season crops, 70-75°F day and 60°F night
        - (2) Cool season crops and tomatoes, 70-75°F day and 45-50°F night

6. Have students tell what spotting out seedlings is and describe the processes involved. Show the students some seedlings in the proper stage for spotting out. (Use TM-8.)

   **Describe the steps in the process of spotting out seedlings.**

1) Spotting out is the transferral of thickly sown seedlings to another plant growing container, so that they will have enough room to grow into a good transplant.
2) Spot seedlings when they are about 1 inch tall and still in the cotyledon stage. (Show TM-8.)
3) Steps in spotting out seedlings.
    a) Fill containers with moist medium.
    b) Press hole into center of medium pot as deep as seedling roots.
    c) Carefully remove seedlings; lift them out with a flat wooden pot label.
        (1) Don't pull them out.
        (2) Hold them by the cotyledon, not the stem
    d) Immediately place the seedling in the punched hole and gently but firmly press medium around the roots
    e) Water the seedling.

7. Discuss water management in regard to vegetable transplants.

**What are some rules for watering vegetable seedlings?**

1) Proper watering requires practice.
2) It is easy to overwater.
3) Do not allow containers to stand in water.
4) Top water until water begins running out the bottom
5) Do not water again until plants show a need for water
    a) Squeeze soilless media to see if there is adequate moisture.
    b) Observe wilted seedlings.
6) Do not water with very cold water.

8. Ask the students to discuss "hardening off" of transplants.

**Describe the purpose and process of "hardening off" vegetable transplants.**

1) "Hardening off" transplants is the act of subjecting seedlings to the natural environment in small increments prior to being set out in the garden. This is done so that they will not be so tender and subject to environmental stresses.
2) Hardening is accomplished by
    a) Placing plants outside for 2 to 3 weeks before setting out in the garden
    b) Bringing them indoors if frost is expected
3) It is better to produce healthy, stocky, and vigorous transplants; then hardening off will not be necessary.

9. Describe damping off disease and ask students if they have ever observed its occurrence in their seedlings. Discuss control measures.

**What is damping off and how can it be controlled?**

1) Damping off is a fungal disease that attacks germinating seeds and small seedlings.

2) Prevent contamination.
    a) Use new and clean materials (disinfect).
    b) Prevent excessive wetness.
    c) Do not use non-sterilized soil or medium.
    d) Keep ends of hoses out of dirt and off of the floor.
    e) May use fungicide

F. Other Activities

1. Design and build a cold frame (or hotbed).

2. Visit a greenhouse that produces vegetable transplants for the spring season.

3. Start transplants in school greenhouse for observation and demonstration.

G. Competency

Analyze basic principles of vegetable crop transplant production.

H. Answers to Evaluation

1. a. Sturdy-stocky
    b. Good green color
    c. Disease-free

2. Frame in the ground with a glass sash roof used for starting vegetable transplants

3. Will keep roots intact, easier to transplant and can just be set in the garden pot and all

4. a. Good drainage
    b. Good water-holding capacity
    c. Reasonable cost
    d. Free of weed seed, insects, and diseases
    *other answers may be acceptable

5. Higher

6. Lower

7. To avoid crushing the tender young stem

8. Damping off

9. Hardening off

UNIT - FRUIT AND VEGETABLE PRODUCTION

Lesson 2: Growing Vegetable Transplants

## EVALUATION

1. What are three desirable characteristics of a vegetable transplant?

   a.

   b.

   c.

2. What is a coldframe?

3. What is the advantage of growing transplants in peat containers or pellets?

4. List four desirable characteristics of a growing medium.

   a.

   b.

   c.

   d.

5. Temperatures generally are kept higher/lower during seed germination.

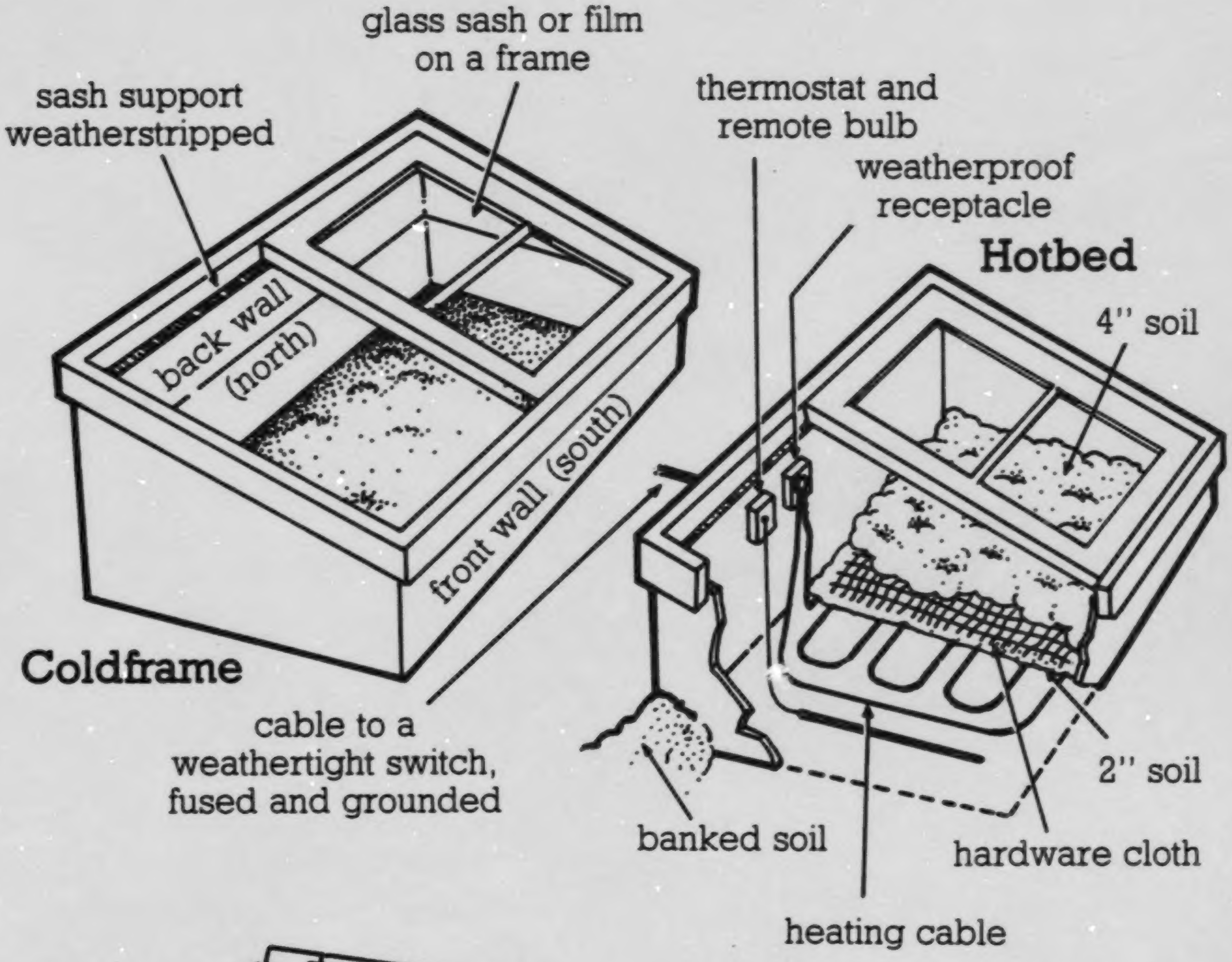
6. Temperatures during seedling growth are kept higher/lower during the night than during the day.

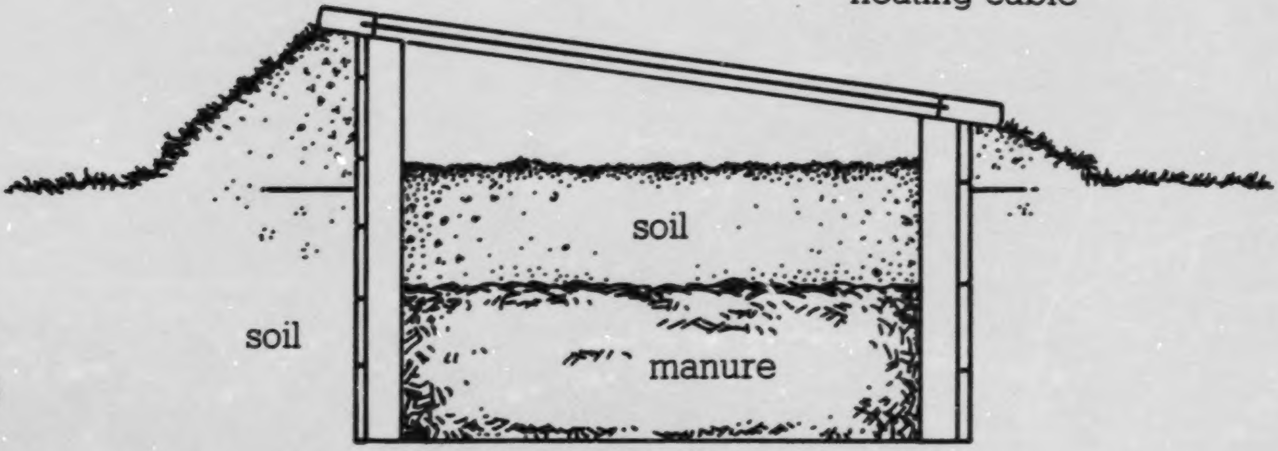
7. Why should a seedling not be handled by the stem when spotting out?

8. _______________ is a disease that kills seedlings.

9. The process of gradually getting transplants used to the garden environment is called_______________________.

# Coldframe Design

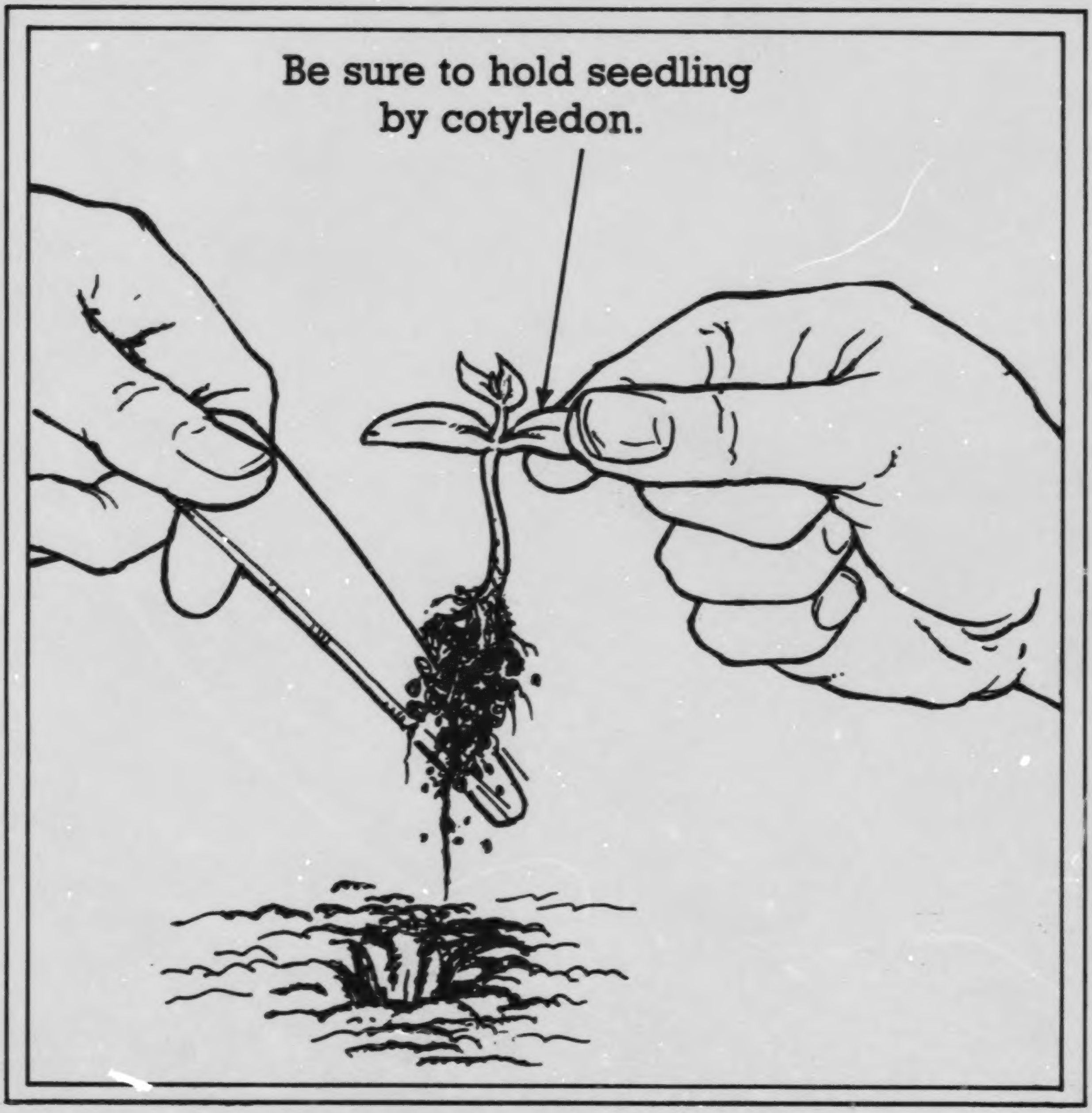

sash support weatherstripped
glass sash or film on a frame
back wall (north)
front wall (south)
Coldframe
cable to a weathertight switch, fused and grounded
thermostat and remote bulb
weatherproof receptacle
Hotbed
4" soil
2" soil
banked soil
hardware cloth
heating cable


soil
soil
manure

Manure Heated Hotbed

TM-8

# Lifting Dicot Seedlings



Be sure to hold seedling by cotyledon.

Pot label is held by other hand and inserted into soil under seedling; then lifted up to bring seedling out of the soil.

UNIT - FRUIT AND VEGETABLE PRODUCTION

## Lesson 3: Warm Season Solanaceous Crops: Tomatoes, Peppers, and Eggplants

Objective: The student will be able to identify characteristics of and techniques for growing solanaceous crops.

Study Questions:

1. Why is the culture of tomatoes, peppers, and eggplants so similar?
2. List desirable qualities of garden tomato varieties.
3. Describe the environmental requirements for tomatoes, peppers, and eggplants.
4. When and at what spacing are tomatoes, peppers and eggplants planted?
5. List one major disease and insect pest of each of these warm season solanaceous crops.
6. Discuss the time for harvesting tomatoes, peppers, and eggplants.

References:

1. Student Reference
2. Gardening for Food and Fun: USDA Yearbook of Agriculture, 1977, pp. 139-146.
3. Handout
    a) HO-9: Pruning Tomatoes
4. Transparency Master
    a) TM-9: Pruning Tomatoes

UNIT - FRUIT AND VEGETABLE PRODUCTION

Lesson 3: Warm Season Solanaceous Crops: Tomatoes, Peppers, and Eggplants

## TEACHING PROCEDURES

A. Review previous lesson.

B. Motivation

Solanaceous crops are members of the deadly nightshade family. Tomatoes at one time in this country were considered highly poisonous and were not eaten.

C. Assignment

D. Supervised Study

E. Discussion

1. Ask students if they have ever grown these crops and to share their experiences. Discuss why these crops have similar cultural requirements. You may want to note that potatoes are a cool season solanaceous crop.

   Why is the culture of tomatoes, peppers, and eggplants so similar?

   1) All members of the same family (solanaceae)
   2) Require virtually the same climatic and cultural conditions
   3) If you can grow one, you can grow the others.

2. Discuss with students and list on the board characteristics that they should be particularly concerned with when choosing tomato varieties.

   List desirable qualities of garden tomato varieties.

   1) Resistance to common diseases
      a) Virticillium wilt (V)
      b) Fusarium wilt (F)
   2) May need resistance to nematodes (N)
   3) Crack resistance; cracks result from alternate wet and dry situations
   4) Growth type
      a) Indeterminant
      b) Determinant
   5) Fruit size
      a) Cherry
      b) Beef Steak

3. Ask students what kind of site they would need to grow these warm season solanaceous crops. Discuss climatic requirements and fertility.

Describe the environmental requirements for tomatoes, peppers, and eggplants.

1) Direct sunlight
2) Fertile soil
3) Well-drained soil
4) About one inch of rain (or irrigation) per week, particularly during flowering and fruit set.
5) Fertilize at planting time.
   a) Five to eight pounds of 5-10-5 per 500 square feet prior to planting on loam soil.
   b) Ten to 20 pounds on sandy soils
   c) Topdress 5-10-5 after fruiting has started
   d) Watch foliage color - should be fairly dark green

4. Have students discuss setting out these crops; include timing, spacing, and support systems. Briefly review desired transplant techniques and pruning (Use TM-9.)

When and at what spacing are tomatoes, peppers, and eggplants planted?

1) Set transplants out.
   a) Tomato - at frost-free date but you can chance earlier setting to get a jump on the market
   b) Peppers and eggplant are more sensitive - set them out 1 or 2 weeks after frost-free date.
2) Spacing
   a) Peppers and eggplants
      (1) 12 to 18 inches between plants
      (2) Rows 30 to 42 inches apart
   b) Tomatoes
      (1) Staked - 18 inches between plants in rows 3 feet apart
      (2) Downs (unstaked) - 3 feet between plants in rows 4 to 5 feet apart
3) Staking allows for ease of cultivation, harvesting, and prevents fruit rot
   a) Peppers and eggplants are not staked
   b) To stake (note the use of wire circles)
      (1) Insert 6 to 8 ft. stake in ground shortly after transplanting
      (2) Tie plants as they grow - lightly twine to stake then gently loop tomato plant about 2 to 3 inches above leaf stem
   c) Prune (suckering) - pinch off small shoots in axil of leaf. (TM-9)

5. Discuss and list the major insect pests and diseases of your area. Ask your students to tell of their experiences. Also discuss sanitation in regard to disease and insect control.

List one major disease and insect pest of each of these warm season solanaceous crops.

DO NOT FILM THIS PAGE

1) Tomatoes
   - a) Insects - aphids, flea beetle, hornworm, fruitworm, spider mites, leaf miner
   - b) Diseases - virticillium wilt, fusarium wilt, blossom end rot, viruses

2) Peppers
   - a) Insects - leaf miner, aphids, budworms, flea beetles, cutworms, hornworms, weevils, pepper maggot
   - b) Diseases - damping off, bacterial leaf spot, phytopthora root rot, mosaic virus

3) Eggplant
   - a) Insects - flea beetle, aphids, lace bugs, Colorado potato beetle
   - b) Disease - verticillium wilt, phomopsis rot

6. Ask students to describe how they would know when to harvest each of these crops.

   What indicates when the vegetables are ready for harvest for each of these crops?

   1) Tomatoes
      - a) 60 to 90 days
      - b) Harvest after fully ripe and red.
      - c) Fruit will detach with a slight twist.

   2) Peppers
      - a) 70 days for green peppers and 130 days for hot, red peppers
      - b) Green, sweet peppers are picked when they reach a good usable size; they should be dark green and firm
      - c) Red peppers can be harvested immature (still green) or allowed to ripen to red
      - d) Harvest by breaking stem from the pepper leaving the stem on the plant

   3) Eggplant
      - a) First harvest 85 to 90 days after transplanting
      - b) Harvest when of sufficient size
      - c) Harvest before skin color becomes dull, flesh tough, and seeds hardened.

F. Other Activities

1. Bring to class examples of ripe eggplants, tomatoes, and peppers to exhibit their appearance.

2. Grow plants in greenhouse and use as examples while discussing crops.

3. Visit local grocery store and tour the fruit and vegetable section.

G. Competency

Identify characteristics and production practices for warm season solanaceous crops.

H. Answers to evaluation

1. b.

2. cracking

3. indeterminate, determinate

4. tomatoes

5. a. V = verticillium wilt resistance
   b. F = fusarium wilt resistance
   c. N = nematode resistance

## UNIT - FRUIT AND VEGETABLE PRODUCTION

### Lesson 3: Warm Season Solanaceous Crops: Tomatoes, Peppers, and Eggplants

### EVALUATION

1. Which is not an environmental requirement for warm season solanaceous crops?

    a. fertile soil
    b. indirect sunlight
    c. well-drained soil
    d. at least 1 inch of rain weekly

2. Tomato ______________ is the result of alternate wet and dry periods.

3. _________________ type tomatoes continue to grow and get fruit while

    _________________ types ripen nearly all their fruit at one time.

4. Which crop can be set out on the frost free date?

    a. tomatoes
    b. peppers
    c. eggplant

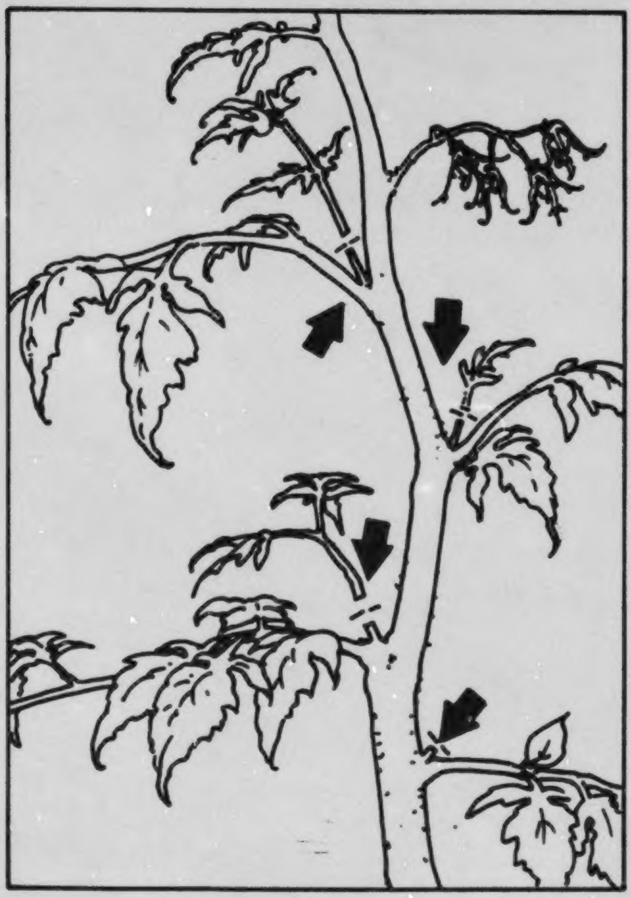
5. What letters should you look for after a tomato variety's name when selecting varieties for production and what do they mean?

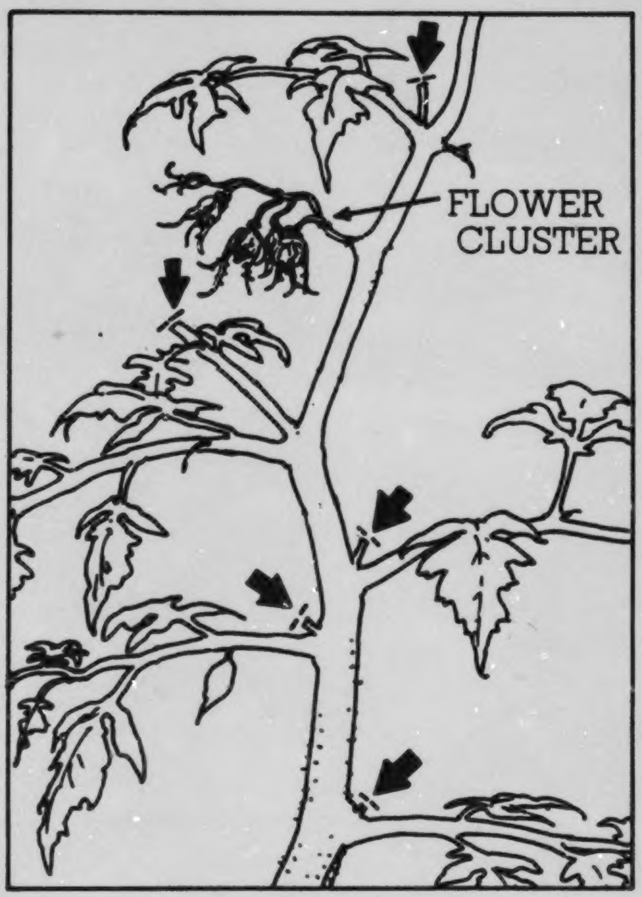
    a.

    b.

    c.

# Pruning Tomatoes





**Basic Pruning**

Remove all side shoots or suckers when they are 3 to 4 inches long by grasping between thumb and forefinger and pulling outward and down.

**Missouri Method**

To increase yields by 15 to 25 percent, remove all suckers except those *directly below* flower cluster. When these suckers grow to 6 inches, pinch out growing tip of sucker, leaving 2 leaflet branches.

**NOTE:**
Do not remove the suckers with a knife, because virus diseases can easily be transmitted from plant to plant.

UNIT - FRUIT AND VEGETABLE PRODUCTION

Lesson 4: Beans, Peas and Sweet Corn

Objective: The student will be able to identify characteristics of and techniques for growing beans, garden peas, and sweet corn.

Study Questions:

1. Discuss why garden peas are planted early and beans are planted later.
2. Describe the growing requirements for snap beans.
3. Identify and compare the two basic growth habits of beans.
4. What can we do to reduce the incidence of disease and insects in snap beans?
5. When should snap beans, green shell beans, dry beans, and garden peas be harvested?
6. Why should sweet corn never be planted next to different types of corn?
7. Discuss the environmental requirements of sweet corn.
8. When is sweet corn harvested?

References:

1. Student Reference
2. Gardening for Food and Fun: USDA Yearbook of Agriculture, 1977, pp. 171-186.

UNIT - FRUIT AND VEGETABLE PRODUCTION

Lesson 4: Beans, Peas and Sweet Corn

TEACHING PROCEDURES

A. Review previous lesson

B. Motivation

Ask students to relate their experiences growing these crops. These are good starter crops for beginning producers, and there is a great deal of demand for these crops.

C. Assignment

D. Supervised Study

E. Discussion

1. Discuss the fact that beans and peas are both legumes (as is the field soybean) but that they differ in their cultural requirements. Discuss these requirements and emphasize that peas are an early season crop.

   Discuss why garden peas are planted early and beans are planted later.

   1) Beans are a warm season crop
      a) Easily injured by frost
      b) Early planted beans just require a longer time to mature a crop.
   2) Peas are a cool season crop.
      a) Peas mature their crop best in cool, spring weather.
      a) They must be planted early for maximum yield.

2. List on the board the cultural requirements for cultivating snap beans. Ask students to relate these requirements to you.

   Describe the growing requirements for snap beans.

   1) Plant after frost free date.
      a) Soil should be warm (60-85° F).
      b) Seeds germinate poorly in cold soils.
   2) Soils should be well-drained and fairly fertile.
      a) Should have good tilth and be friable
      b) Avoid crusting of soil surface (inhibits seedling emergence).
   3) Require constant but not great quantity of water
      a) Important for bud formation and pod set
      b) Excessive or too little water causes blossom and pod drop.

3. Discuss the difference in growing bush and pole beans. Ask students which type is grown in your area.

   Identify and compare the two basic growth habits of beans.

   1) Bush types
      a) Low growing, self-supported
      b) Quick production - several successive plantings
   2) Pole types
      a) Vine that must be supported
      b) Long season - one planting per season

4. Discuss insect and disease problems of your area. Ask students what problems they have encountered and what control measures they took. Emphasize garden sanitation -- the practice of keeping garden clean of clutter and plant debris that might harbor disease and insects.

   What can we do to reduce the incidence of disease and insects in snap beans?

   1) Use disease free, Western-grown seed.
   2) Do not soak seed prior to planting.
   3) Plant disease-resistant varieties.
   4) Use treated soil.
   5) Practice cleanliness and sanitation.
   6) Do not handle or harvest plants when wet.
   7) Control insects with insecticides.

5. List on the board the indices of harvest for each of the crops.

   When should snap beans, green shell beans, dry beans, and garden peas be harvested?

   1) Snap beans - harvest when pods are still young, seed is small, interior flesh is firm, and pod fiber content is low.
      a) Proper picking stage lasts only a few days.
      b) Delay in harvest means a reduction in quality.
   2) Green shell beans - harvested and shelled after the seeds are nearly full-grown but before they are hardened and dried.
   3) Dry beans - harvested after the pods mature and are at least partially dried
   4) Garden peas - harvest when pods are well-filled but before they begin to harden or fade in color
   5) Edible pod peas are harvested before the seeds develop very much.

6. Discuss the background of sweet corn. Ask students if they have ever planted sweet corn with field corn and what happened.

   Why should sweet corn never be planted next to different types of corn?

1) Pollen from other types of corn will contaminate the sweet corn causing kernels to be starchy and not sweet

2) Standard sweet varieties vs. extra sweet varieties--same condition exists

7. Have students identify the climatic and moisture requirements for cultivating sweet corn. List these on the board.

   Discuss the environmental requirements of sweet corn.

   1) Essentially a warm season crop
      a) Easily killed by frost or injured by prolonged cold temperatures
      b) Germinate seed at soil temperatures greater than 50° F.
      c) Best in areas having mean temperature of 65° to 75° F during growing season
   2) Sixty-five to 100 day growing season
   3) Soils should be well-drained and friable.
      a) Deep, loamy, rich soil is preferred.
      b) pH 5.8 to 6.8
   4) Fertilizer applications recommended. (Check with local recommendations.)
   5) Continuous and adequate moisture supply
      a) Twenty or more well-distributed inches of water
      b) Rain or irrigation needed every week after tasseling.
   6) Be sure of regional variety adaptations.

8. Discuss stage of ear development in regard to harvest. Also discuss the utilization of successive plantings to provide a continuous supply of sweet corn throughout the season.

   When is sweet corn harvested?

   1) When the kernels are in the milk stage
   2) When silks are brown and dry
   3) When ear is enlarged and husk is lightly filled
   4) Kernels are large, soft, tender, and filled with a sweet, opaque, milky juice
   5) Harvest 17 to 24 days after silk emergence. (Time varies with weather conditions.)
   6) Passes prime very quickly
   7) Pick early in morning and refrigerate immediately (loses quality very quickly after harvest).

F. Competency

Identify basic characteristics and techniques for growing beans, peas, and corn.

## G. Answers to Evaluation

1. legumes, cool, early, warm, after
2. inhibits seedling emergence
3. bush, pole
4. keeping garden clean of clutter and plant debris that might harbor disease and insects
5. starchy
6. milky, refrigerated (or cooled)

UNIT - FRUIT AND VEGETABLE PRODUCTION

Lesson 4: Beans, Peas and Sweet Corn

## EVALUATION

1. Beans and peas are both ____________ but peas are a ____________ season crop and should be planted ____________ while beans are a ____________ season crop and should be planted ____________ the frost free date.

2. What is the effect of soil surface crusting on bean and pea seedling emergence?

3. What are the two growth habit types of beans?

   a.

   b.

4. What do we mean by garden sanitation?

5. Sweet corn planted next to field corn will most likely be ____________ because of pollen contamination.

6. Sweet corn is harvested when kernels are in the ____________ stage; the ears should be harvested in the morning and ____________ immediately.

UNIT - FRUIT AND VEGETABLE PRODUCTION

Lesson 5: Cole Crops and Cucurbits

Objective: The student will be able to identify characteristics of and techniques for growing cole crops and cucurbits.

Study Questions:

1. List the various cole crops and discuss their common climatic preference.
2. Discuss the establishment (planting and cultivation) of the major cole crops, including timing and spacing.
3. Describe the harvested, edible portion of cabbage, broccoli, cauliflower and Brussels sprouts, and tell when each is harvested.
4. Why are hybrid ($F_1$) varieties superior?
5. Describe desirable environmental requirements for germinating cucurbit seed and growing the vines.
6. Why is the cucumber beetle so detrimental to cucurbit production? What measures can we take to control this pest?
7. What diseases are destructive to cucurbits? What measures can we take to control them?
8. Discuss when to harvest the various cucurbit crops.

References:

1. Student Reference
2. Gardening for Food and Fun: USDA Yearbook of Agriculture, 1977, pp. 133-138, 187-195.
3. Handout
    a. HO-10: The Twelve-spotted and Striped Cucumber Beetles
4. Transparency Master
    a. TM-10: The Twelve-spotted and Striped Cucumber Beetles

UNIT - FRUIT AND VEGETABLE PRODUCTION

Lesson 5: Cole Crops and Cucurbits

TEACHING PROCEDURES

A. Review previous lesson.

B. Motivation

Watermelons and muskmelons (cucurbits) are favorite crops with high cash value. Cole crops provide a means of stretching the growing season beyond that of warm season crops.

C. Assignment

D. Supervised Study

E.. Discussion

1. Have students name the various cole crops and ask them to explain why they are culturally related (they are also botanically related).

   List the various cole crops and discuss their common climatic preference.

   1) Cauliflower, broccoli, cabbage, brussels sprouts, kohlrabi
   2) This group of vegetables develops best in moderately cool weather and shorter fall days. (In hot weather harvest period is short with less quality and lower yields.)

2. Have students list the steps in planting cole crops, both by seedlings and transplanting. List these steps on the board. Emphasize time of planting.

   Discuss the establishment (planting and cultivation) of the major cole crops, including timing and spacing.

   1) Cole crops are widely adapted and can be established almost anywhere if proper planting dates are selected
   2) Soils should be fertile, deep, well-drained, sandy or silt loams
      a) Adapted to wide range of soil conditions
      b) pH 6.5 - 7.0
   3) Transplanting - saves 2-3 weeks growing time over seeding
      a) Transplant should be 4-5 weeks old with 3-5 true leaves and healthy.
      b) Can transplant seedlings (if seed is sown) and they will mature 10 to 14 days later than undisturbed seedlings, extending harvest.
      c) For summer harvest, plant in early spring.
      d) For fall harvest plant during summer.
      e) When direct seeding, sow seed approximately 2 weeks, earlier than transplants for similar harvest date.

f) Use flat or bed culture.
    (1) Beds are used when drainage is poor.
    (2) On wider beds 2 rows (12-14 inches apart) are common except with Brussels sprouts
    (3) Spacing
        (a) 30 to 36 inches between rows
        (b) Cabbage, cauliflower and brocolli - 15 to 24 inches between plants within rows
        (c) Brussels sprouts - 30 to 36 inches between plants within rows
g) Supply adequate moisture (1 to 1 1/2 inches weekly)

3. Show the harvested portion of each of the major cole crops (either pictures or real vegetables) and describe where they are located on the plant. Ask students to tell how they will know it is harvest time for each example.

Describe the harvested, edible portion of cabbage, broccoli, cauliflower, and Brussels sprouts and tell when each is harvested.

1) Cabbage - heads develop in center of plant
    a) Heads are usable as soon as they become fairly firm.
        (1) Early varieties 55 to 70 days after transplanting
        (2) Later varieties 110 to 120 days
    b) Heads will split open soon after they reach harvest stage.
    c) In summer axillary heads may develop after initial harvest.
2) Cauliflower
    a) White heads in the center of the plant are harvestable as soon as they reach a suitable size.
    b) Cut heads before they become "ricey."
3) Broccolli - green buds and flower stems in center of tall plant
    a) The center shoot (harvested portion) is 5 to 10 inches across.
    b) Harvest before bud begins to separate or show yellow color.
        (1) Pass edible condition quickly in warm weather
        (2) After center head is cut smaller side shoots will develop and be harvested.
4) Brussels sprouts - the small buds along the tall stem are harvested.
    a) Harvest sprouts 1 to 1 1/4 inches in diameter
    b) Remove leaf below the sprout and break or cut the sprout off.
        (1) Harvest as long as sprouts develop
        (2) Debudding (cutting out terminal of plant) after plants are 15 to 20 inches tall encourages a single uniform harvest.

4. Review concept of hybrid vigor. Discuss the availability of hybrid cole crop varieties and why these are more desirable than standard varieties.

Why are hybrid ($F_1$) varieties superior?

1) Hybrid varieties of cauliflower, cabbage, broccoli, and Brussels sprouts are available
    a) More uniform plant size
    b) More uniform maturity
    c) More uniform head size
    d) Greater total yield

5. Ask student to describe the climatic and cultural requirements for growing the cucurbits after they have listed all the popular cucurbit crops. Discuss the fact that all the cucurbit crops are extremely uniform in their requirements.

Describe desirable environmental requirements for germinating cucurbit seeds and growing the vines.

1) Cucurbits are tropical in origin and as such they thrive during the long, hot, humid days and warm nights of summer.
2) Cucurbits require a great deal of space because vining plants are quite vigorous.
3) Temperatures
    a) Extremely frost tender plants; will not function below 60°F.
    b) Germinate seed at 60 to 70° F.
    c) Maximum season of growth at average mean temperatures of 65 to 85° F.
4) Soils - cucurbits are not exacting.
    a) Well-drained, aerated
    b) Enriched with plant compost or animal manure
    c) Best on sandy loams but can be grown on heavier soils
    d) Must have pH of 7.0 or slightly more alkaline
5) Nutrients
    a) Fertile soil
    b) Benefit greatly from organic materials such as green and animal manures worked into hills
6) Plant cucurbits in hills.
    a) Cover seeds with soil 1 to 3 inches deep.
    b) Plant 4 to 5 seeds per hill; then thin to 1 or 2 healthy plants.
7) Moisture
    a) Maintain moisture throughout soil profile as cucurbits are deep-rooted.
    b) Keep water off of leaves to discourage foliar diseases.

6. Show a picture (TM-10) of the striped and spotted cucumber beetles. Discuss how insects vector plant diseases using the cucumber beetle and cucurbits as a primary example. If time permits, you may wish to discuss other insects and diseases prevalent in your area.

Why is the cucumber beetle so detrimental to cucurbit production? What measures can we take to control them?

1) Cucumber beetles spread the bacterial wilt disease that is very harmful to cucurbit plants.
   a) Adults feed on plants and destroy them.
   b) Adult beetle feeding spreads bacteria causing bacterial wilt.
   c) The bacterial wilt disease plugs the water transportation system (xylem) within the plant, resulting in wilting and death of the plant.
   d) Beetle larvae bore into the plant stems and roots below soil level, causing plants to die.
   e) Control at first sign with labeled insecticide.
2) Other insect pests include aphids, squash bug, and squash vine borer.

8. List the major cucurbit crops and discuss the indices for harvesting each.

**Discuss when to harvest the various cucurbit crops.**

1) Proper timing at harvest is crucial for obtaining maximum cucurbit fruit quality.
   a) Cucumbers
      (1) Pickling - when fruits are 2 to 4 inches long, approximately 3 to 4 days after flower opening (Delay for larger pickles.)
      (2) Slicing types are harvested when fruit is 8 to 10 inches long.
   b) Muskmelons - harvest when abcission layer forms.
      (1) A crack-like circle will be around the stem where it meets the fruit
      (2) Never force the stem to detach.
   c) Honeydew and casaba melons do not have the abcission layer; harvest them when the blossom end of the fruit is soft and the melon changes color.
   d) Watermelon - knowledge of harvest time is acquired through experience.
      (1) Rap melon with knuckles.
         (a) Dull, flat sound indicates maturity.
         (b) Crisp, metallic sound indicates immaturity.
      (2) Ground spot (underside of melon) changes from white to yellow.
   e) Summer squash - consumed immature
      (1) Harvest when 3 to 6 inches long.
      (2) Harvest 2 or 3 times per week.
   f) Winter squash
      (1) Harvest when mature.
      (2) Skin will be hard and impervious when mature.
   g) Pumpkins and gourds - allowed to remain on the vine until frost destroys the vines

F. Other Activities

1. Obtain examples of as many cucurbit fruits as possible and allow class to compare them.

## G. Competency

Identify the basic characteristics of and techniques for growing cole crops and cucurbit crops.

## H. Answers to Evaluation

1. broccoli, cabbage, cauliflower (and others), cool, short, fall
2. Harvest season is shorter, yield is less and quality is poorer
3. Transplants shorten the growing season.
4. a. uniform plant size
   b. greater total yield
   c. uniform maturation
5. True
6. True
7. 1-2
8. to reduce chances for foliar diseases to occur
9. Bacteria proliferate in the xylem (water transport) system plugging the vessels up. Bacterial wilt is spread by the striped and twelve-spotted cucumber beetles.

UNIT - FRUIT AND VEGETABLE PRODUCTION

Lesson 5: Cole Crops and Cucurbits

## EVALUATION

1. Cole crops include ____________, ____________, ____________ and generally they all produce higher quality crops in ____________ weather and ____________ days.

2. What happens to cole crop yields during hot weather?

3. What is the main advantage of using cole crop transplants as opposed to direct seeding?

4. List 3 reasons why hybrid plants are superior

   a.

   b.

   c.

5. True or False (circle one): Cucurbits are extremely frost tender.

6. True or False (circle one): Cucurbits require a soil pH no lower than 7.0 for best performance.

7. Cucurbits are generally grown with ___________ healthy plants per hill.

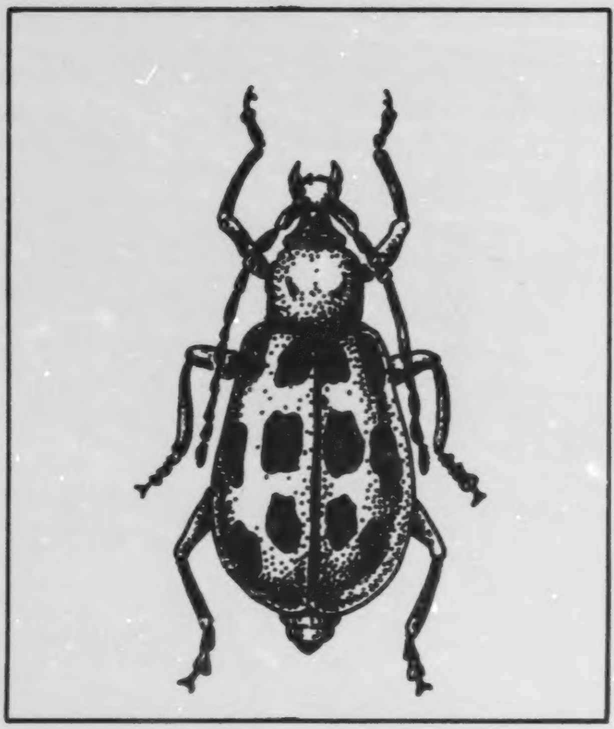
8. Why is it a good idea to keep water off of cucurbit leaves?

9. How does bacterial wilt kill cucurbit plants and how does the disease spread?

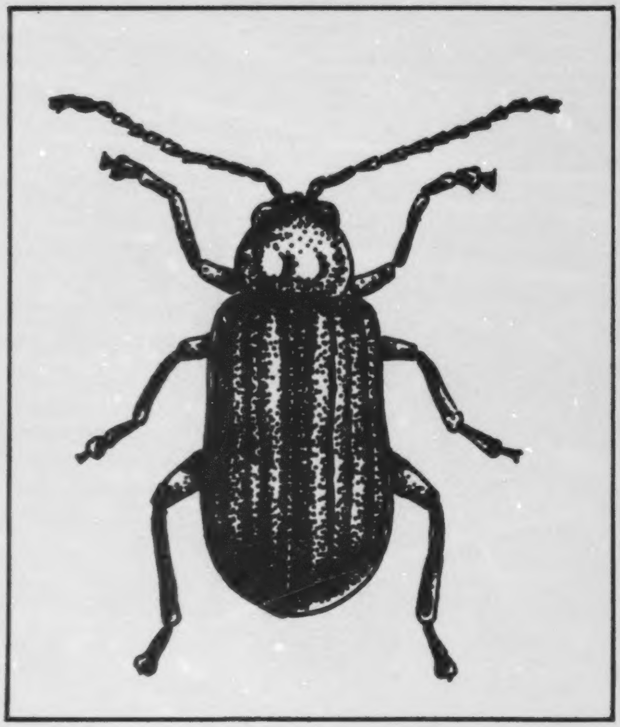
10. We know when muskmelons (cantaloupes) are ready to harvest by the formation of the ____________ layer.

TM-10

# The Twelve-spotted and Striped Cucumber Beetles



Twelve-spotted Beetle



Striped Beetle

UNIT - FRUIT AND VEGETABLE PRODUCTION

## Lesson 6: Growing Apples and Peaches

Objective: The student will be able to identify the characteristics of and accepted techniques for growing apples and peaches.

Study Questions:

1. **Discuss apple and peach orchard site selection in regard to climatic factors and soil characteristics.**
2. **Discuss apple and peach flower pollination including blooming time and methods of pollen transmissal.**
3. **Differentiate between dwarf, semi-dwarf, semi-vigorous, and vigorous trees in regard to apple tree rootstocks.**
4. **What factors affect the ultimate size of trees and, as such, tree spacing in the orchard?**
5. **Outline the handling of apple and peach tree nursery stock from receiving the shipment through pruning the newly set-out tree.**
6. **Describe the basic concepts involved in training apple trees to the central leader system.**
7. **What are the major types of orchard pests and generally how is each type controlled?**
8. **How and why are apple and peach crops thinned?**
9. **When are apples and peaches harvested?**
10. **How are bearing peach trees pruned?**

References:

1. Student Reference
2. Gardening for Food and Fun: USDA Yearbook of Agriculture, 1977, pp. 246-259.
3. Handouts
    - a) HO-11: Air Drainage and Frost Pockets
    - b) HO-12: Apple Variety Bloom Period Chart
    - c) HO-13: Grafted and Interstem Apple Trees
    - d) HO-14: Rootstock Height Comparison
    - e) HO-15: Planting Distances for Apple Trees
    - f) HO-16: Planting Plans to Provide for Cross-pollination
    - g) HO-17: Fruit Tree Pruning Terminology
    - h) HO-18: Pruning Newly Set Peach Trees
    - i) HO-19: The Central Leader Pruning System for Apples
    - j) HO-20: Pruning Mature Peach Trees

4. Transparency Masters

a) TM-11: Air Drainage and Frost Pockets
b) TM-12: Apple and Peach Variety Bloom Period Chart
c) TM-13: Grafted and Interstem Apple Trees
d) TM-14: Rootstock Height Comparison
e) TM-15: Planting Distances for Apple Trees
f) TM-16: Planting Plans to Provide for Cross-pollination
g) TM-17: Fruit Tree Pruning Terminology
h) TM-18: Pruning Newly Set Peach Trees
i) TM-19: The Central Leader Pruning System for Apples
j) TM-20: Pruning Mature Peach Trees

UNIT - FRUIT AND VEGETABLE PRODUCTION

Lesson 6: Growing Apples and Peaches

TEACHING PROCEDURES

A. Review previous lesson and briefly introduce the topic of fruit production.

B. Motivation

There are about 6,000 different apple varieties. Pilgrims hand-carried their favorite apple cultivars as small saplings when they first came to America. Missouri, at one time, was the largest apple producing state in the Union but now ranks 15th to 20th. It is still known for its outstanding Jonathan apple crops.

C. Assignment

D. Supervised Study

E. Discussion

1. Elaborate on how site selection (particularly topography) and climatic factors are important considerations in orchard establishment. (Show TM-11 to illustrate the movement of frost.)

   Discuss apple and peach orchard site selection in regard to climatic factors and soil characteristics.

   1) Climate is very important
      a) Winters need to be sufficiently cold for fruit tree chilling requirement.
      b) Extremely cold weather will kill trees.
         (1) -45°F will kill apple trees; 28°F or lower will kill the flower buds.
         (2) Bark and/or flower bud injury is caused by less severe temperatures
      c) Peach flower buds are injured by temperatures of 0°F
         (1) All peach buds will be killed at -12°F.
         (2) Lower temperatures can injure or kill trees.
      d) Late spring frost can damage apple and peach flower buds.
         (1) Flowers are very susceptable to low temperatures just prior to, during, and just after flowering.
         (2) Air drainage is crucial in protecting fruit trees from late spring frosts
         (3) Plant on sloping (5 to 10 percent) land so cold air will drain away.
   2) Soil characteristics
      a) Apples grow on a wide range of soils.
         (1) Ideal soil is well-drained, fertile, sandy loam at least four feet deep, pH no lower than 5.5.
         (2) Apples will not tolerate "wet feet," i.e., soils remaining wet into late spring.

b) Peaches
  (1) Requirements are the same as for apples.
  (2) pH 5.5 to 6.5
3) Plant in full sun.

2. Ask students to discuss the different pollination habits of peaches and apples in regard to orchard planning. Also discuss the important role of bees in producing in a fruit crop. Review the concepts of self-fertile and self-sterile plants. (Use TM-12.)

**Discuss apple and peach flower pollination including blooming time and methods of pollen transmissal.**

1) Pollination is essential for the setting of flowers to initiate fruit development.
  a) Apple varieties are self-sterile; they cannot be fertilized by their own pollen.
    (1) Provide cross-pollinization with any other variety. (within 100 ft. or 2 rows)
    (2) Pollen source does not affect apple characteristics.
  b) Peach varieties are nearly all self-fertile.
    (1) Trees set fruit with their own pollen.
    (2) Avoid varieties that are self-sterile.
2) Varieties differ in their time of blooming.
  a) There are early and late-blooming varieties.
  b) Plan to overlap these for sufficient cross-pollination or plant two varieties of each blooming time type.
3) Bees carry pollen from one variety to another.
  a) They fly at temperatures above 65°F.
  b) High winds prevent bee flight.
  c) If bees do not fly during the bloom period there will be no flower pollination and no fruit set.

4. Discuss what a rootstock is and the effect of rootstocks on apple tree growth. Note that there are no effective dwarfing stocks for peaches though there are genetic dwarf peach varieties. Ask students to discuss the merits of dwarf orchards in comparison with standard orchards. Point out tree height differences, yield per tree differences, and yield per acre differences. (Show TM-13 and TM-14.)

**Differentiate between dwarf, semi-dwarf, semi-vigorous and vigorous trees in regard to apple tree rootstocks.**

1) Rootstocks are the portion of grafted trees that will serve as the tree's roots.
  a) Rootstocks may possess a characteristic that the variety is lacking, for example, drought resistance, tolerance to wet soil, insect or disease resistance, in addition to size controlling effects.
  b) Both apples and peaches are grafted onto rootstocks.
  c) Dwarfing (size reducing) rootstock are a beneficial innovation.
    (1) Characteristics of dwarfing stocks include:

    - (a) More expensive
    - (b) Come into bearing earlier (precocious)
    - (c) Easier to prune, spray, and harvest
    - (d) Greater yields per acre
    - (e) Fruit is the same as standard size trees
    - (f) Same life span as standard size trees
  - (2) Tree size at maturity will depend on the rootstock used.
    - (a) Dwarf on Malling M. 9 or M. 27 roots, 5 feet
    - (b) Semi-dwarf on M.26 (12 feet), M.7 (15 feet)
    - (c) Semi-vigorous on Malling-Merton MM.106 or MM.111, 20 feet
    - (d) Vigorous on seedling rootstock with no dwarfing effect (30 feet or more)
    - (e) Interstem trees have a rootstock, a six-inch trunk section and the scion variety on top. This is called double budding.
      - (1) The rootstock provides strong, vigorous roots while the interstem portion provides dwarfing effect.
      - (2) For example Jonathan/M.9/MM.106 for a semi-dwarf tree. (Read as Jonathan on M.9 on MM.106.)

4. Ask students to list the factors affecting the size of trees and discuss this in relation to spacing of trees in the orchard. (Use TM-15 and TM-16.)

   What factors affect the ultimate size of fruit trees and as such tree spacing in the orchard?

   1) Rootstocks (as previously discussed)
   2) Inherent varietal vigor - some varieties are more vigorous than others and will grow bigger
   3) Soil fertility - trees will grow bigger in more fertile soils
   4) Severity of pruning - contrary to popular belief, pruning can be an invigorating practice
   5) Precociousness and amount of fruit set - fruit is matured at the expense of vegetative growth
   6) Climatic conditions - sunshine, length of growing season, severity of weather, and moisture

5. Have students describe the proper techniques for handling young fruit trees. (Show TM-17 and TM-18.)

   Outline the handling of apple and peach nursery stock from receiving the shipment through pruning the newly set out trees.

   1) Trees are should be ordered from a commercial nursery.
   2) It is best to order smaller trees for better survival and greater initial tree growth (Have the class look through a commercial catalog)
   3) Trees are dormant when shipped; keep them that way until planting time by "heeling in" or refrigeration.

a) Immediately upon receiving your trees they should be unwrapped and inspected.
b) The roots must be kept moist and above freezing. Inspect your trees regularly while in storage.
4) Plant apple and peach trees as early in the spring as is possible. (Fall planting is practiced in some areas but is riskier)
a) Trees should be planted while still dormant or with very few leaves.
b) Orchard area is prepared by plowing and disking.
c) Prune off dead or injured roots and those that are excessively long.
d) Dig a large hole for the tree.
(1) Large enough so that roots are not crowded or bent out of their natural position
(2) Never twist roots around the perimeter of the hole.
(3) Make sure graft unions are well-above the soil line.
(4) Keep the trees in a bucket or trough of water while being transported in the orchard to prevent the roots from drying out.
(5) Put topsoil in the bottom of the hole.
(6) Hold the tree at the desired planting depth and fill in soil around the roots.
(a) Tamp the soil with your feet while gently pulling the tree up and down to settle the soil around the roots.
(1) Make sure roots are in good contact with the soil.
(2) No air pockets
(b) Water in.
(c) Remove all tags - wire and string will girdle trees.
5) Pruning
a) Apples
(1) Cut off top of tree to 30 inches and cut off half of the side branches (called laterals or scaffolds).
(2) Leave no side branches below 18 inches.
(3) Dwarf apples may have to be stacked.
b) Peaches
(1) Prune to a single upright stem 24 to 36 inches high.
(2) Cut at a mature bud.
(3) If there are wide angled, strong side branches (laterals), choose 3 spaced evenly about the trunk and separated by no more than 6 inches of trunk. Top these to even lengths and remove the remaining laterals. Trees will be developed into a 3 scaffolded open-vase type tree.

6. Discuss the development of trees using a central leader pruning technique. Discuss the do's and don'ts of pruning. (Show TM-19.)

Describe the basic concepts involved in training apple trees to the central leader system.

1) Pruning fruit trees is an art that can be learned through practice.
2) Begin training (pruning) fruit trees their first season and prune every season thereafter.
3) Prune in late winter or early spring to avoid winter injury.
4) During the first two years select branches along the main stem.
    a) Approximately 4 laterals for every 2 feet of trunk.
    b) Cut off all branches lower than 20 inches.
    c) Tip back laterals to encourage feathering and equal vigor of laterals.
    d) Choose a central leader; an upright branch in the center of the tree that is shorter than the lateral branches.
        (1) It is from the leader that laterals chosen in subsequent years will arise.
        (2) A new leader is selected each year as the tree grows. Keep the leader shortened to prevent the tree from growing too high
    e) Rules for pruning
        (1) Heavy pruning encourages overvegetativeness at the expense of fruiting.
        (2) Limited pruning can be size-controlling.
        (3) Overpruning will delay bearing - prune only as necessary.
        (4) As trees mature, less and less pruning will be necessary as they "settle" into bearing.
        (5) Cut off branches which cross each other.
        (6) Cut out vigorous upright suckers and branches growing straight downward.
        (7) Thin out branches for sunlight and spray material penetration.
        (8) Sunlight is necessary for fruit coloring and fruit bud differentiation.
        (9) Make pruning cut neatly and as close to the stem as possible; do not leave stubs.
        (10) Spread limbs to 45° angles.
        (11) Use spreaders on large limbs and clothespins on smaller limbs.

7. Discuss orchard pest control. List the types of pests and general control measures. Show the students Extension Service pesticide spray schedules

What are the major types of orchard pests and how is each type controlled?

1) Pest control is difficult.
2) Types of pest control
    a) Insects are controlled by sanitation and scheduled applications of insecticides.

- b) Weeds - herbicides and mowing for control
- c) Fungi - apply recommended fungicides, and orchard sanitation for control
- d) Virus
  - (1) Remove dead or infected trees and burn for control.
  - (2) Prune with clean equipment.
- e) Rodents - protect trunks with wire screen wrap around; keep orchard well mowed; rotenticides can be used
  - (1) Mice chew trunks
  - (2) Rabbits eat bark and young trees
- f) Deer
  - (1) Will often eat tender buds.
  - (2) There is no confirmed control measure.

8. Ask students to discuss why fruit crops are thinned and how they are thinned.

**How and why are apple and peach crops thinned?**

- 1) Thinning the crop on apple and peach trees is necessary when too many fruits are set.
  - a) Thinning results in larger, better quality, better colored fruits, and prevents limb breakage
  - b) Apple tree thinning also discourages alternate bearing tendencies.
- 2) Thin apples to 1 fruit per spur spaced 4 to 6 inches apart, remove all fruit from the leader.
- 3) Thinning is accomplished by chemical application of growth regulating substances.
- 4) Peach thinning must be done early for large fruit.
  - (a) Thin peaches mechanically with 1 1/2 foot rubber hose attached to the end of a broom handle.
  - (b) Beat the limbs to knock fruit off.
  - (c) Leave 1 peach every 6 to 8 inches.

9. Discuss the timing of apple and peach harvest. List the indices of harvestability. Also discuss the mechanics of harvesting.

**When are apples and peaches harvested?**

- 1) Peaches - harvest when ground color changes from green to yellowish; also press with pad of fingers in cupped hand to indicate softness.
  - a) Peaches for commercial uses must be picked three to seven days before soft ripeness to withstand handling and shipping.
  - b) Harvest only those on the tree that are ripe, allowing remaining fruit to ripen for later harvest.
  - c) Pick peaches in a shallow container (usually a peck basket) and handle very gently to avoid bruising the fruit.
- 2) Apples - harvest when fruits are fully colored and have developed a good eating quality.
  - a) Sampling the fruit is the best indicator.

        b) Some fruits will begin to drop when ripe, but others will not drop even when over-ripe.
        c) Fall varieties tend to ripen uniformly but early summer varieties may need to be harvested over a period of time.
    3) To pick apples and peaches, hold the fruit in your whole hand, not just the finger tips. Otherwise, palm the fruit to avoid bruising.
        a) Give the fruit a quick firm twist to detach
        b) Some varieties are inherently more delicate than others. For example, Golden Delicious apples bruise extremely easily.

10. Discuss the pruning of mature peach trees. Emphasize the importance of height control. (Show TM-20.)

    **How are bearing peach trees pruned?**

    1) Keep vigorous current-season wood for the bearing of next season's crop.
        a) Cut the tops back to a reasonable picking height (8-12 feet).
        b) Maintain balance of vigor between scaffolds - maintain open vase by keeping the middle open.
    2) Prune to renew bearing wood annually.
    3) Peaches are somewhat self-pruning, i.e., branches will shade out and die.

## F. Other Activities

1. Have a practice day for pruning and setting out fruit trees.

2. Visit a local orchard and observe operations in progress. If you go in early spring or late winter you will be able to observe pruning; in later spring you may be able to observe tree planting.

## G. Competency

Identify principles and techniques for cultivating apples and peaches.

## H. Answers to Evaluation

1. chilling
2. frosts
3. to protect flowers from late frosts, provides for cold air drainage
4. a. well-drained
    b. at least four feet deep
    c. fertile
5. fertile, infertile, cross-pollination

6. a. earlier bearing
   b. greater per acre yields
   c. easier to prune, spray, harvest
7. Late winter or early spring
8. to keep roots from drying out
9. central leader, open vase
10. county extension office
11. thinning results in bigger, higher quality and better colored fruits

UNIT - FRUIT AND VEGETABLE PRODUCTION

Lesson 6: Growing Apples and Peaches

## EVALUATION

1. Fruit trees need sufficiently cold winters to satisfy their __________ requirements.

2. Late spring ____________ can damage fruit tree buds and flowers.

3. Why are fruit tree plantings located on sloping hillsides?

4. List three important soil characteristics for fruit tree orchards.

   a.

   b.

   c.

5. Peaches are self ____________ while apples are self ____________ and require ____________.

6. List 3 benefits of size controlling rootstocks.

   a.

   b.

   c.

7. When are fruit trees most generally planted?

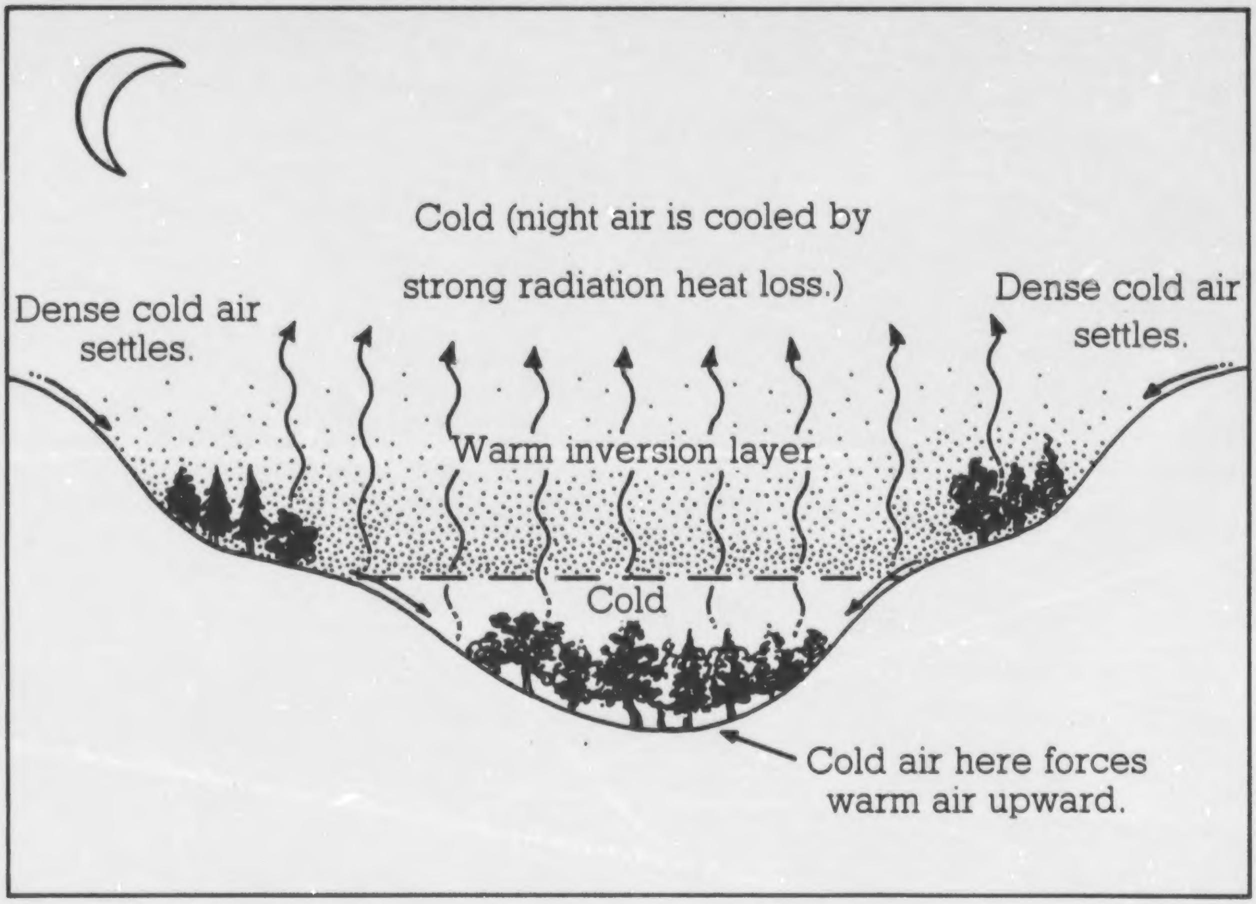
8. Why are fruit trees kept in a bucket of water during planting?

9. Apples are pruned to a ____________ ____________ system while peaches are pruned to an ____________ ____________ system.

10. Where is information regarding fruit tree pest control available?

11. Why is fruit thinning important?

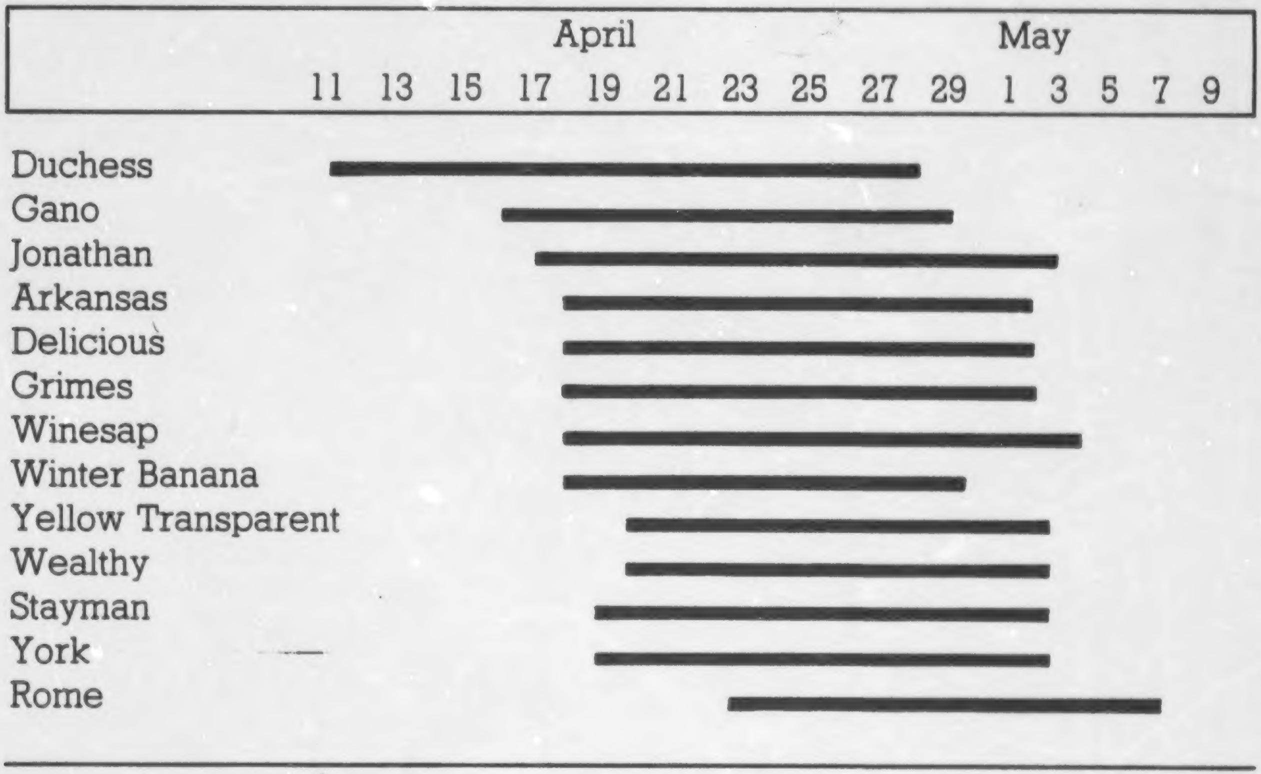
# Air Drainage and Frost Pockets


Cold (night air is cooled by
strong radiation heat loss.)
Dense cold air settles.
Dense cold air settles.
Warm inversion layer
Cold
Cold air here forces warm air upward.

Schematic view of a valley with trees planted on the floor and up a slope. On clear, still nights, strong radiation heat loss at the earth's surface cools the air. This dense cold air settles at the bottom of the valley, forcing warmer air up to a higher level-thus producing a temperature inversion. Temperature inversions are advantageous to trees on the slope on frosty nights.

# Apple Variety Bloom Period Chart

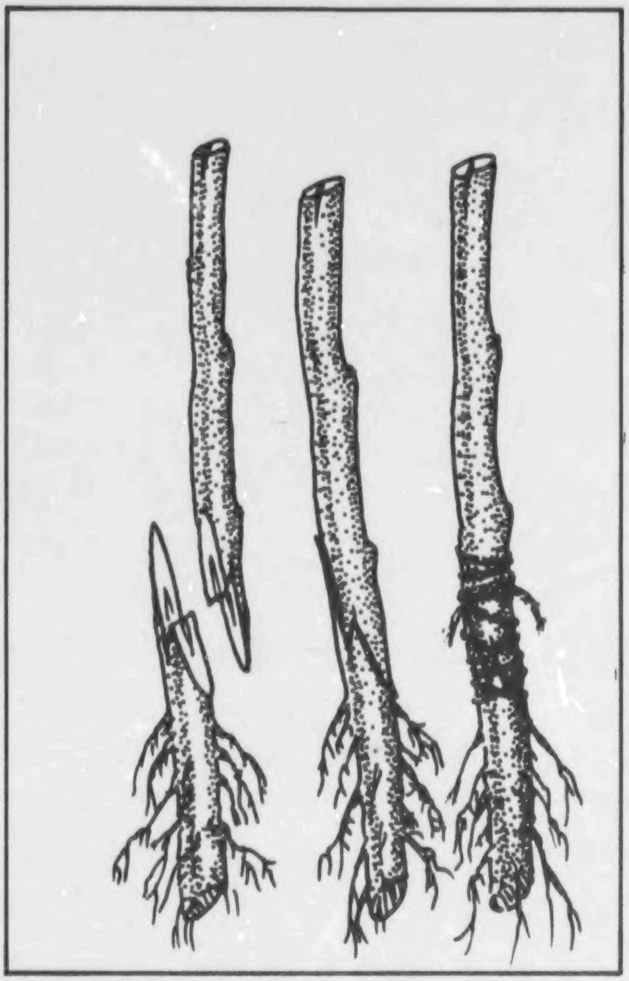
## Average Bloom Periods of Apples in Central Missouri

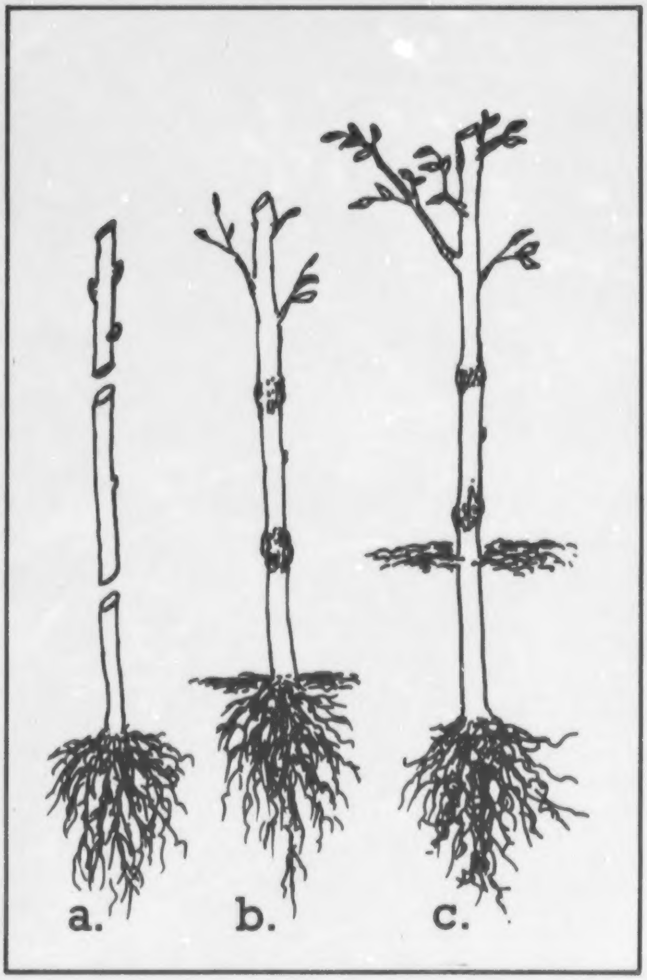


Source: Murneek (1947)

TM-13

# Grafted and Interstem Apple Trees

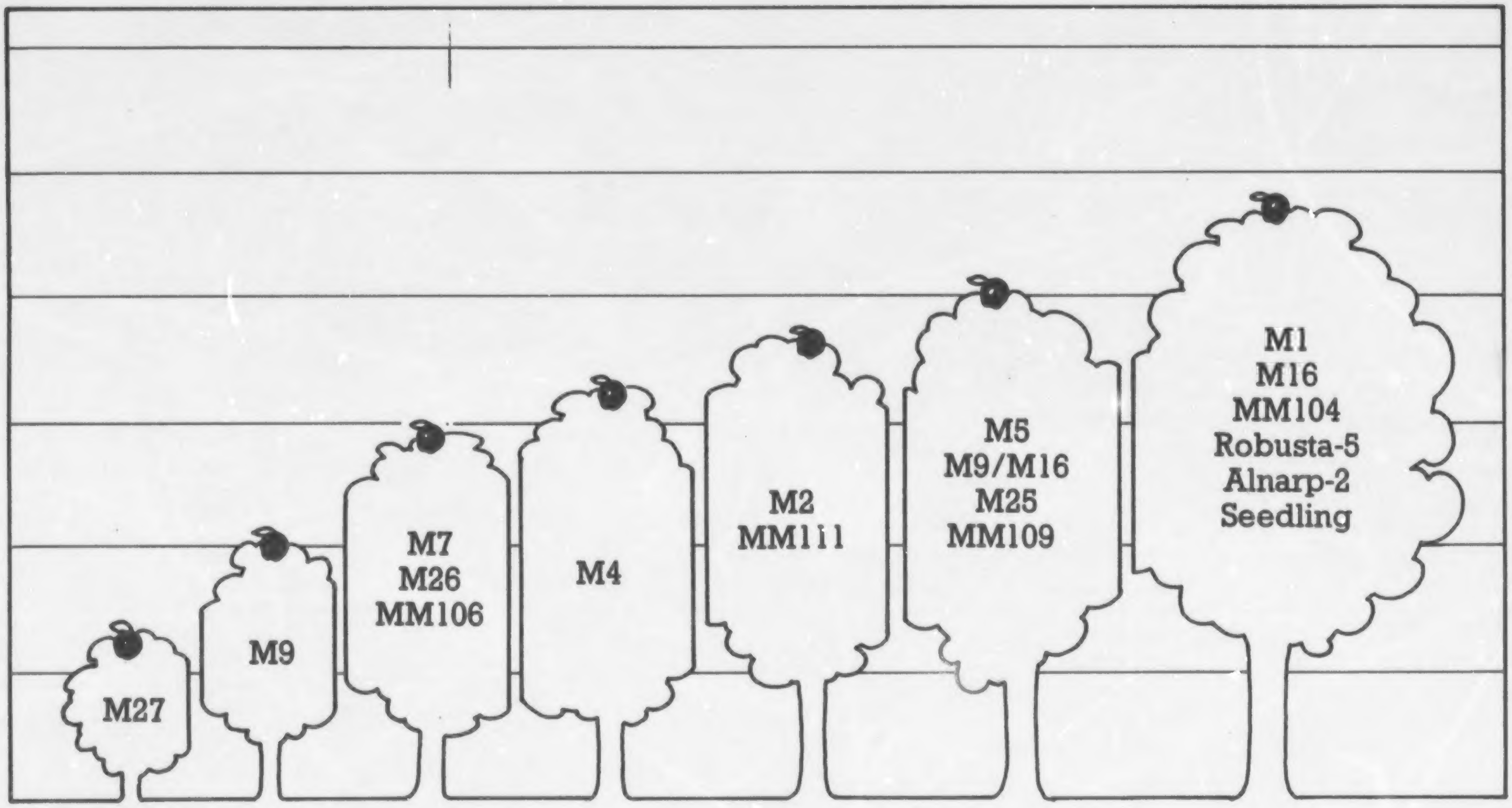




Varieties of fruit trees do not come true to seed. During the dormant season, pieces of shoot wood are removed from the desired variety and whip-grafted on roots or clones of the same or a closely related fruit. Above system of propagation can be used for apples.

To develop a stronger deeper root sytem, horticulturists are testing full-dwarfing interstems (6-8 inches) such as virus-free M.9 or root-stock MM.111. The development of this type of tree is shown above on (a) the grafting bench, (b) in the nursery, and (c) in the orchard.

# Rootstock Height Comparisons



Approximate relative size of apple trees on different rootstocks.

TM-15

# Planting Distances for Apple Trees

## Compact Apple Trees

| Spacing in Rows and Between | Trees Per Acre | Clonial Rootstock | Comments |
|---|---|---|---|
| 6 x 14 | 518 | EM IX, M26 | Any Variety |
| 8 x 16 | 340 | EM VII, MM106 | Rome, York, Jonathan |
| 10 x18 | 242 | EM VII, MM106, EM II | G. Del., Jon., Spy |
| 12 x 20 | 182 | EM VII, MM106, EM II | Stay., McIn., Jon., Spurs |
| 14 x 22 | 141 | MM104, MM111 | Rome, York, Jon. Spurs |
| 16 x 24 | 114 | MM104, MM111 | G. Del., Delicious |
| 18 x 26 | 93 | MM104, MM111 | Stayman, McIntosh |
| 18 x 26 | 93 | Robusta (hardy) | Canadian varieties |
| 20 x 28 | 78 | MM109, EM XVI, seedling | Any variety |

## Compact Tree Size by Variety

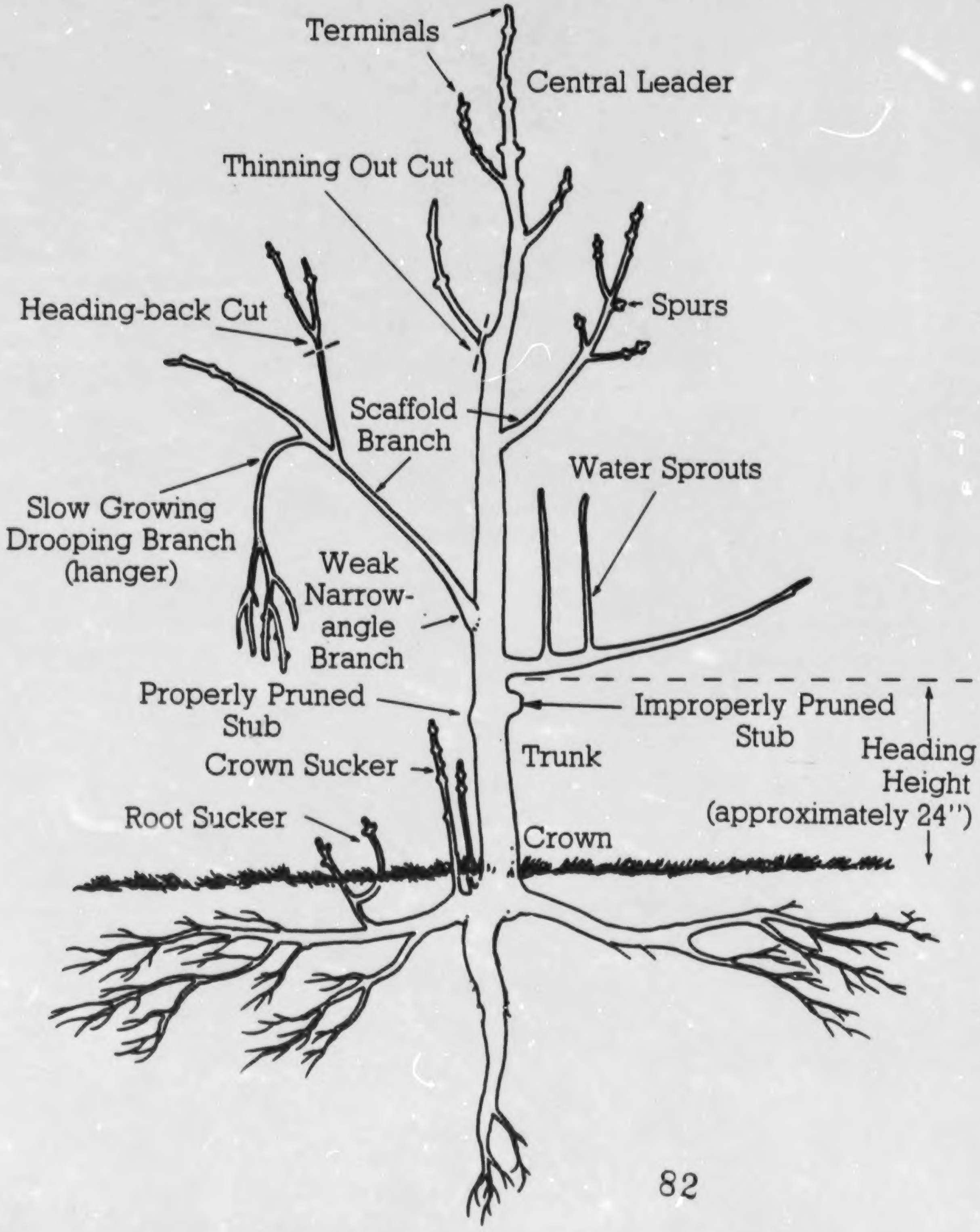
| 30'W x 20'H<br>EM 16<br>Std. Seedling | 25'W x 17'H<br>MM109, 111,<br>EM XII | 22'W x 17'H<br>MM104, EM II | 15' x 10'H<br>MM106, EM VII |
|---|---|---|---|
| Jonathan | Jonathan | Jan. Rome | G. Del. N. Spy |
|  | Spur. Del. | G. Del. York | McIn. Idared |
|  | Rome | McIn. Stay | Del. Beacon |
|  | York | Sp. Del. N. Spy | Stay. S. Rambo |

(Standard Size Apple Trees - 35 ft. to 45 ft.)

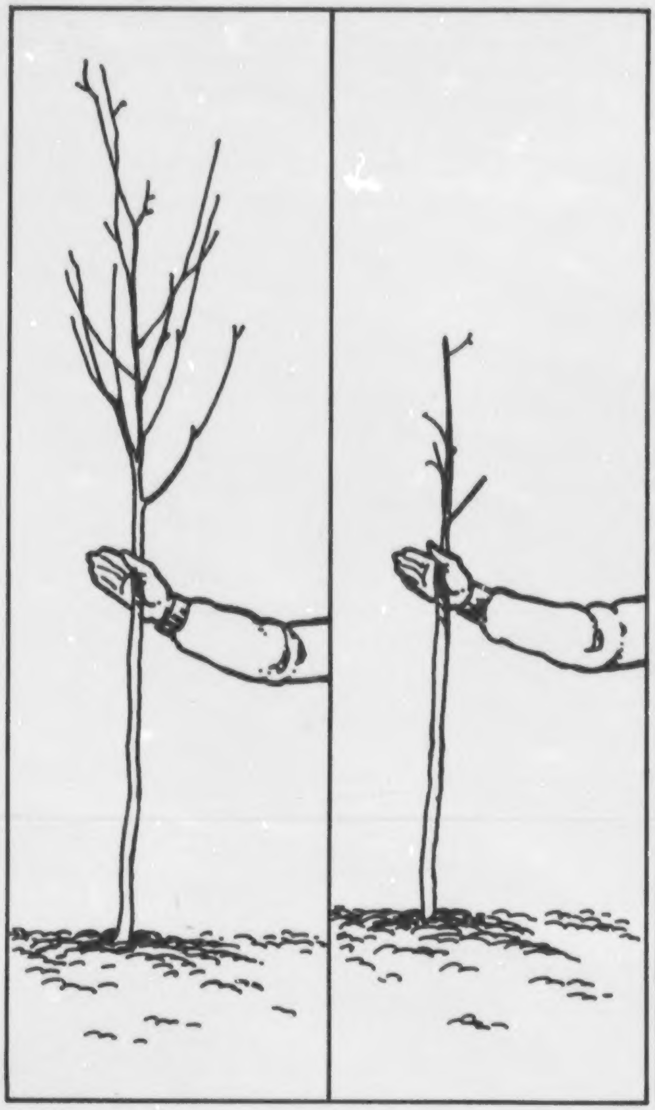
# Planting Plans to Provide for Cross-pollination

| Every Third Tree in Every Third Row a Pollinizer | Every Fifth Row a Pollinizer Cultivar | Cultivars in Alternate Blocks of Three Rows D-Delicious, S-Spy, M-McIntosh |
|---|---|---|
| X X X P X X X ● ● ● ● | P X X X X P X ● ● ● ● | D D D S S S M M M ● ● ● ● |
| X X X X X X X | P X X X X P X | D D D S S S M M M |
| P X X X X X P | P X X X X P X | D D D S S S M M M |
| X X X P X X X | P X X X X P X | D D D S S S M M M |
| X X X X X X X | P X X X X P X | D D D S S S M M M |
| P X X X X X P | P X X X X P X | D D D S S S M M M |
| ● | ● | ● |
| ● | ● | ● |
| ● | ● | ● |
| ● | ● | ● |
| ● | ● | ● |

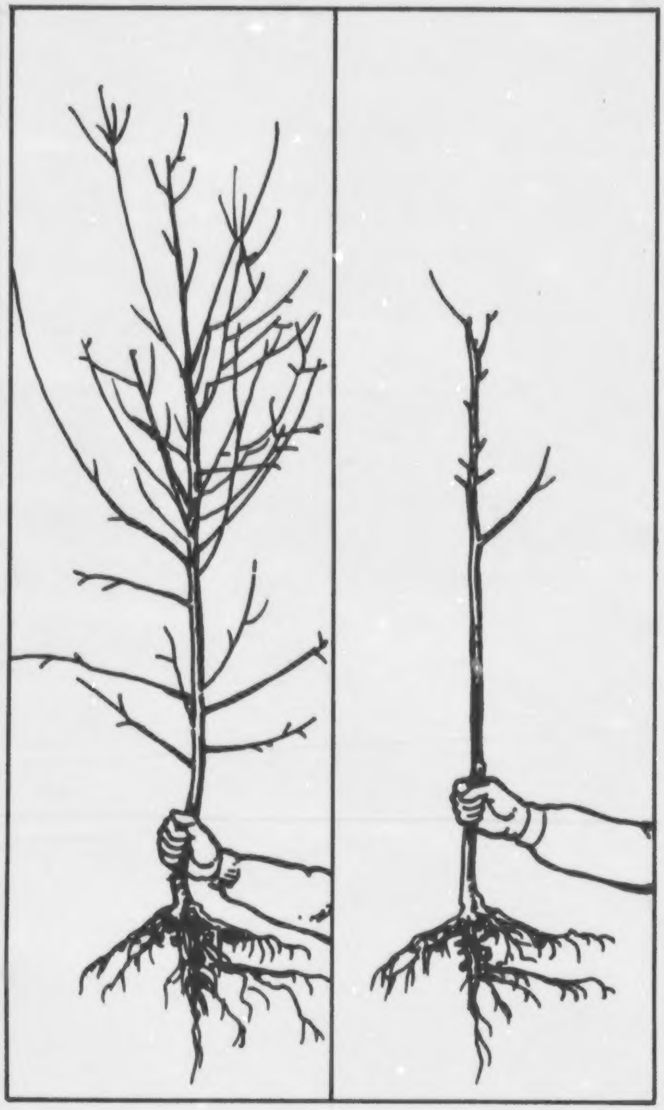
# Fruit Tree Pruning Terminology


Terminals
Central Leader
Thinning Out Cut
Heading-back Cut
Spurs
Scaffold Branch
Water Sprouts
Slow Growing Drooping Branch (hanger)
Weak Narrow-angle Branch
Properly Pruned Stub
Improperly Pruned Stub
Crown Sucker
Trunk
Heading Height (approximately 24")
Root Sucker
Crown

# Pruning Newly Set Peach Trees

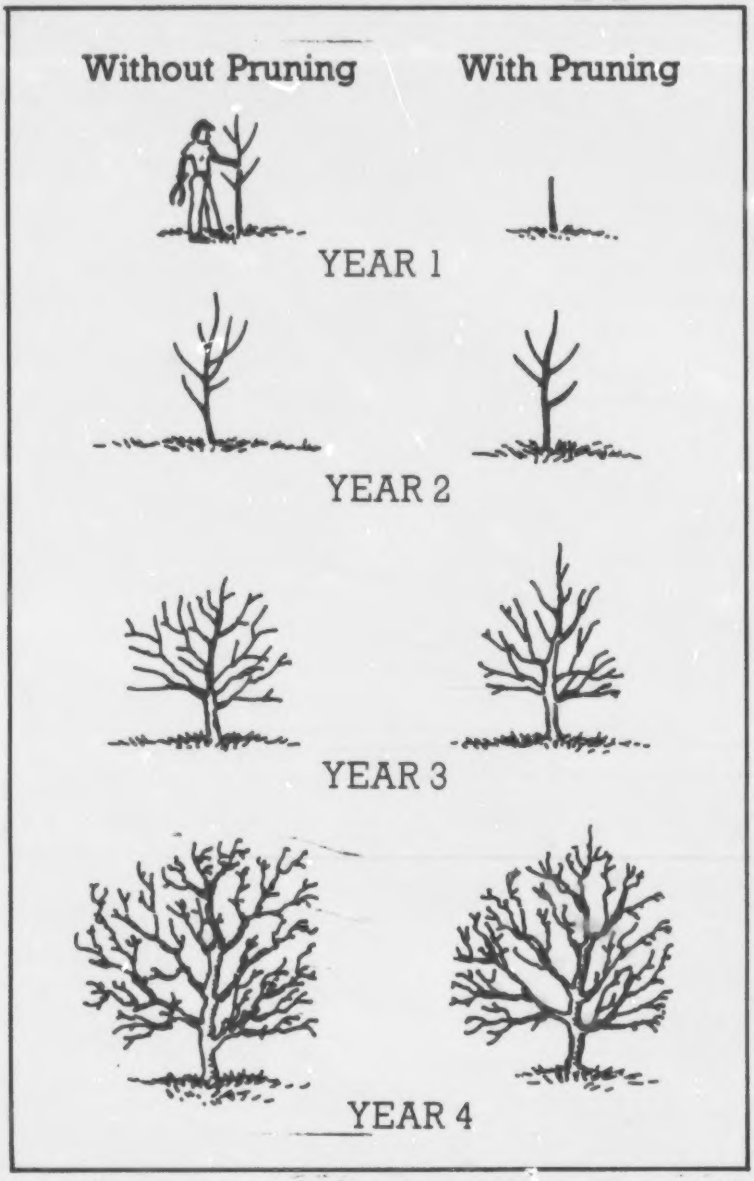


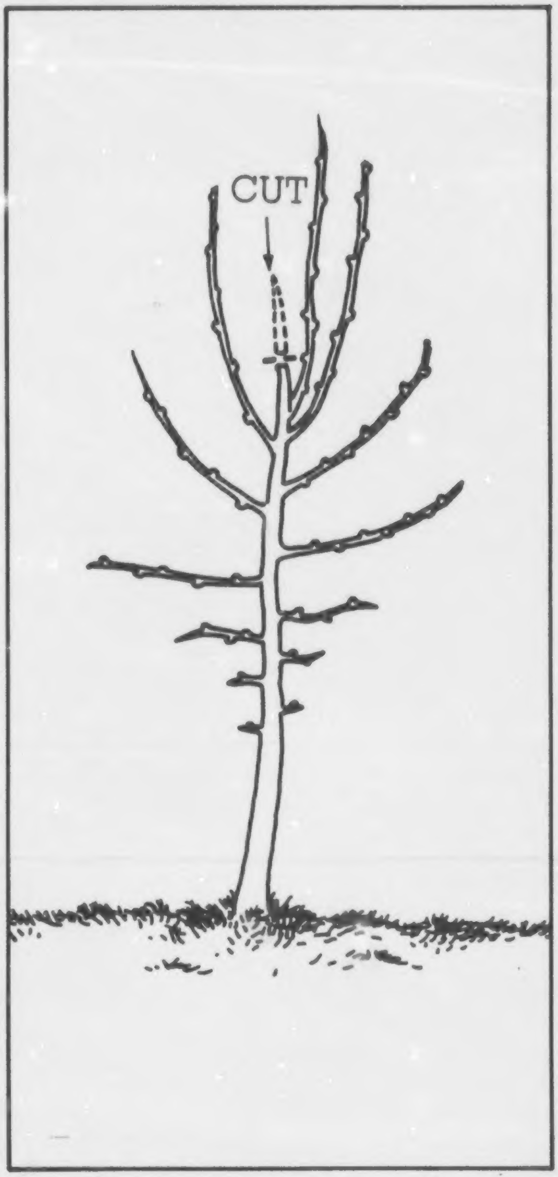
One-year peach tree before and after pruning. The tree was cut back to 30 inches and four well-distributed side branches were left and cut back to short stubs to assist in developing an open-center head.



One-year peach tree before and after the top and branches were pruned. Vigorous branches were shortened but not stubbed.

# The Central Leader Pruning System for Apple Trees

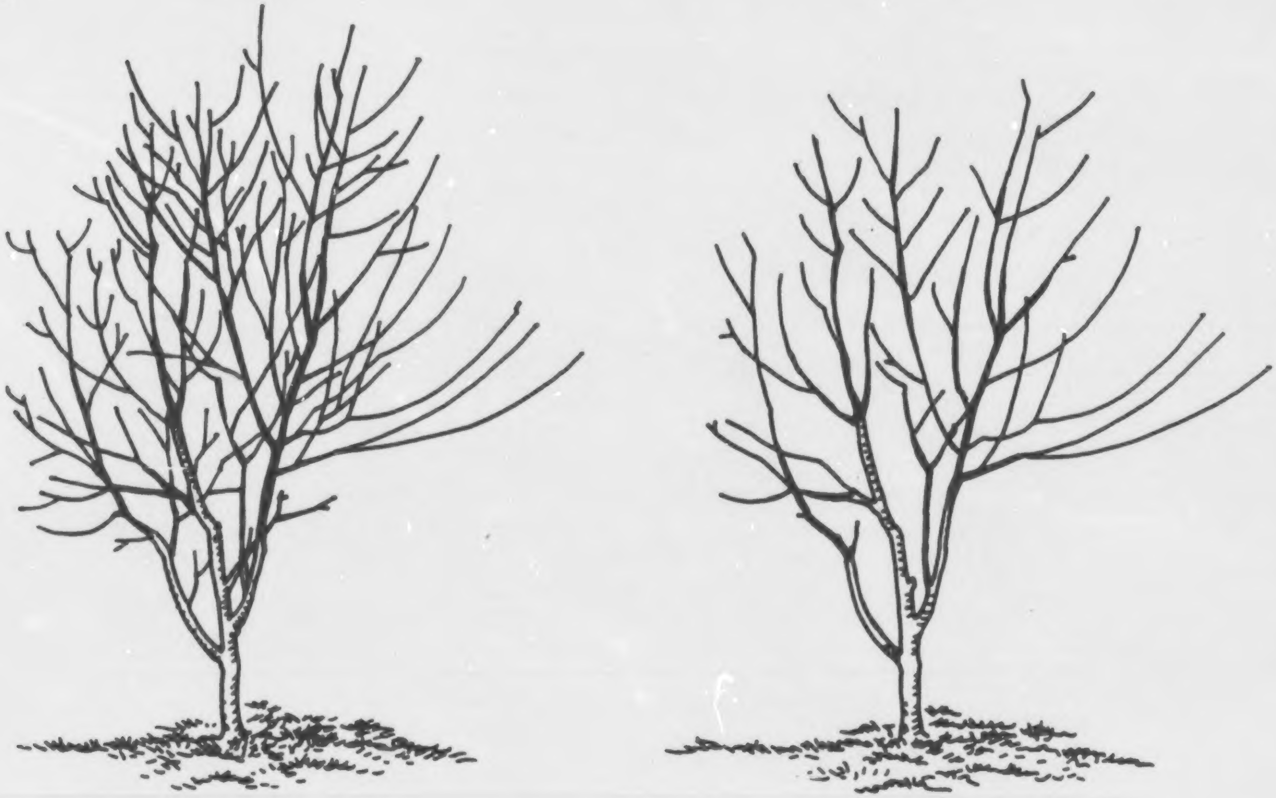

Without Pruning
With Pruning
YEAR 1
YEAR 2
YEAR 3
YEAR 4

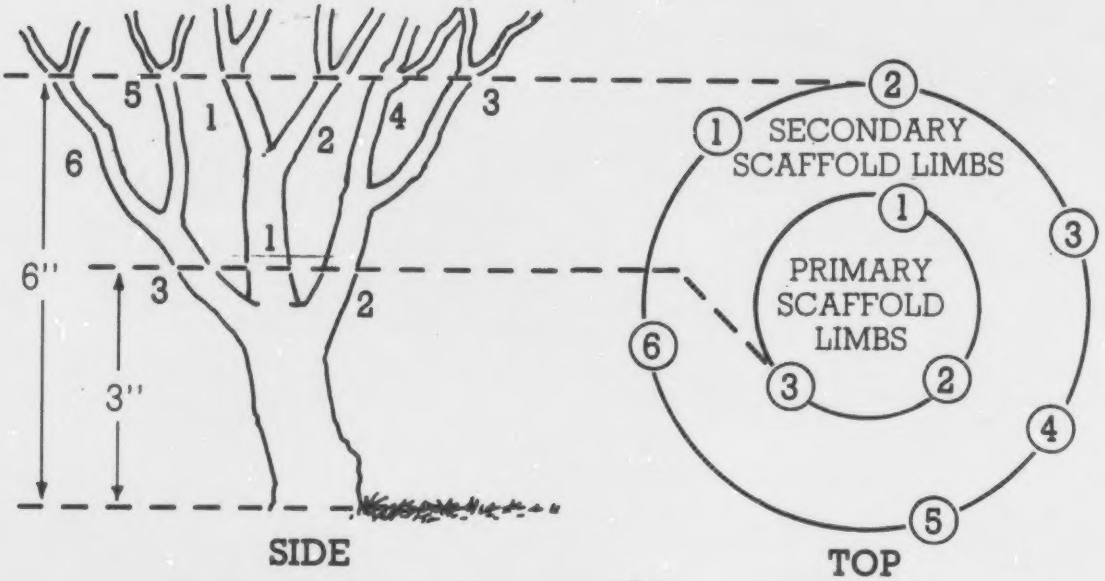


The pruned tree shows the pattern of growth expected when the unbranched tree is headed back at planting and allowed to grow without further training after the first season. Upper branches are the most vigorous and have the narrowest crotch angles. Dominance of the upper branches creates a hormonal balance that results in wider branch angles and shorter growth of lower branches.

# Pruning Mature Peach Trees

Two-year peach tree before and after pruning. Scaffold limbs were headed slightly and several small branches were cut out of center.




5
1
2
4
3
6
1
6''
3
2
3''
SIDE
2
1
SECONDARY
SCAFFOLD LIMBS
1
3
PRIMARY
SCAFFOLD
LIMBS
6
3
2
4
5
TOP

UNIT - FRUIT AND VEGETABLE PRODUCTION

Lesson 7: Strawberries

Objective: The student will be able to identify characteristics of and techniques for growing strawberries.

Study Questions:

1. Describe environmental characteristics conducive to strawberry cultivation.
2. Discuss the pollinating and bearing habits of strawberries.
3. What are some important considerations when selecting and buying nursery stock?
4. List the steps for establishing a strawberry patch including first season care.
5. Why and how do we mulch strawberry patches?
6. Describe when and how to harvest strawberries.
7. Describe the process of renewing a strawberry patch.
8. Why is irrigation important for growing strawberries?

References:

1. Student Reference
2. Gardening for Food and Fun: USDA Yearbook of Agriculture, 1977, pp. 265-271.
3. UMC Horticulture Guide 6130: Strawberry Varieties for Home Fruit Production
4. Handout

   HO-21: Strawberry Planting Depths
5. Transparency Master

   TM-21: Strawberry Planting Depths

UNIT - FRUIT AND VEGETABLE PRODUCTION

Lesson 7: Strawberries

TEACHING PROCEDURES

A. Review previous lesson.

B. Motivation

Strawberries can be an excellent starting crop for an SOE project. Pick-your-own operations have become exceedingly popular.

C. Assignment

D. Supervised Study

E. Discussion

1. Ask students to list and discuss the preferred soil and climatic conditions for growing strawberries.

   **Describe environmental characteristics conducive to strawberry cultivation.**

   1) Plant in full sun.
   2) Soils - wide range acceptable
      a) Sandy loams are preferred
      b) Well-drained soils preferred
   3) pH - 5.8 to 6.5 is preferred but strawberries are not that sensitive.
   4) Avoid frost pockets in low-lying areas.
   5) Do not plant on steep slopes.
   6) Avoid recently sodded areas or areas used for tomatoes or potatoes.
   7) Avoid sites heavily infested with weeds.

2. Discuss variety selection in conjunction with pollination and bearing habits of strawberries. Note that overbearing type strawberries are generally not thought to be a good choice for commercial producers in the Midwest. Show or supply students with Missouri Cooperative Extension Service Agricultural Guide - G06135.

   **Discuss the pollinating and bearing habits of strawberries.**

   1) Performance (growth and fruiting) of strawberries can differ markedly from one area to another.
      a) Consult your county agent.
      b) Ask growers in the area.
   2) Commercially available strawberries are self-fruitful (require no cross-pollination).
   3) Two bearing types of strawberries are available.
      a) June bearing - produce a single crop each year.
      b) Everbearing

        - (1) Produce one crop during the normal season and one in the fall of that season.
        - (2) Everbearing strawberries are not commercially grown in the Midwest.
    - 4) Eating quality, disease resistance and handling and freezing quality are also important criterion for choosing varieties.
    - 5) Usually early, mid and late season varieties are included in a planting to spread out the harvest season.

3. Discuss the availability of strawberry plants. Possibly show some supplier's catalogs. Point out various points to consider when selecting varieties and suppliers. List these on the board.

   **What are some important considerations when selecting and buying nursery stock?**

   - 1) Get quality plants that are healthy with good roots
   - 2) Are plants true to their name?
   - 3) Order as early as possible
   - 4) Buy only "virus-free" stock if available (labeled "registered virus-free").
   - 5) Buy only certified stock (Indicates free of noxious disease and insects).

4. Have student list and discuss the steps for establishing a strawbery patch. (Use TM-21.)

   **List the steps for establishing a strawberry patch including first growing season care.**

   - 1) Site preparation
     - a) Begin the year before planting if possible
       - (1) Grow green manure crop.
       - (2) Control noxious weeds.
       - (3) Adjust soil fertility levels.
       - (4) Apply animal manures in the fall.
       - (5) In spring, work the soil until it is near seedbed condition.
         - (1) Test soil and adjust fertility levels.
         - (2) Apply soil insecticides.
   - 2) Setting out the plants
     - a) Matted row - most popular with commercial growers in the Midwest
       - (1) Set plants centered 18 inches apart in rows 48 inches apart.
       - (2) No effort to control runners which ultimately occupy a mat 18 to 24 inches wide.
   - 3) Plant in early spring.
     - a) Remove all but 2 or 3 healthy leaves and about 1/3 of the root mass.
     - b) Set plants in soil.
       - (1) Spread roots.
       - (2) Cover roots with soil with crown at the soil surface. This is critical. (See TM-21.)
       - (3) Planting can be done by hand or mechanically.

        - c) Water plants in.
    - 4) First season
        - a) Remove all flowers
        - b) Cultivate throughout season to control weeds and keep runners within the mat area.
        - c) Apply fertilizer if necessary.

5. Discuss the use of mulches in the production of strawberries. Note that heaving also occurs with perennial forage crops (alfalfa). Elaborate on the techniques of applying suitable materials for mulches.

   **Why and how do we mulch strawberry patches?**

    - 1) A mulch is a cover of organic or inorganic material placed on top of or around the crop plant.
    - 2) Strawberries are mulched in the late fall to protect the plants from severe cold and heaving.
    - 3) Mulching material
        - a) Wheat and rye straw are the best.
        - b) Oat straw and leaves are not as good.
    - 4) How to mulch
        - a) Expose straw to weather prior to mulching to get seed in the straw to germinate.
        - b) Apply straw 3-4 inches deep after several sharp freezes have occurred.
            - (1) Do not mulch before growth has stopped.
            - (2) Mulch is placed directly on top of the strawberry plants.
        - c) In spring, fork the straw off of the plants and into the row middles.
            - (1) Helps keep the berries off the ground
            - (2) Helps keep berries cleaner

6. Ask students to discuss when to harvest strawberries (indices of harvestability) and to tell how they are to be picked.

   **Describe when and how to harvest strawberries.**

    - 1) Harvest berries when they are fully colored. (White areas indicate a lack of ripeness.)
    - 2) Pick berries with the stem and cap (green calyx) attached.
        - a) Snap the stem with your thumbnail.
        - b) Berries will store better.
    - 3) Do not expose harvested berries to the sun.
    - 4) Refrigerate as soon as possible.
    - 5) Avoid harvesting when the berries are wet to check the spread of disease.
    - 6) Remove diseased, rotten, and damaged fruits from the patch.
    - 7) Picking is usually done in quart coutainers.

7. Discuss why renewing (usually called renovating) is important in strawberry production. Outline the steps of renewing a patch. Note that weed control is the most crucial element affecting the productive life of a strawberry patch.

Describe the process of renewing a strawberry patch.

1) Renovating is the process of reworking the patch after the bearing season, stimulating new runner formation to form a new mat of plants.
2) If renovation and weed control are done properly, patches can last 3 to 5 years.
3) Renovation starts right after harvest.
    a) Mow off tops of plants.
        (1) Do not damage the crowns from which new growth will arise.
        (2) Mowing is not always done; it largely depends upon the type of herbicide to be used.
    b) Till or plow the matted row to a width of 8 inches.
        (1) Plow both sides or just one.
        (2) Till in organic matter.
    c) Walk along the patch and pull up weeds.
    d) Apply labeled and recommended herbicides.
    e) Another herbicide application will be made in the fall.
    f) Fertilize and irrigate for vegetative regrowth.

8. Ask students if they think irrigation would be important in their region. Review rainfall distribution patterns during the growing season and the water requirements of strawberry plants. Lead students to the conclusion that commercial production of strawberries greatly benefits from irrigation.

Why is irrigation important for growing strawberries?

1) In many seasons, full production cannot be achieved without irrigation.
2) Supplemental irrigation assures good runner formation and good berry size.
3) Supply 1 inch of water per week.
4) Irrigate before plants show stress symptoms.

F. Other Activities

1. Visit a local commercial strawberry patch.

2. Grow some strawberry plants in the greenhouse.

G. Competency

Identify characteristics of and techniques for producing strawberries.

H. Answers to Evaluation

1. a. full sun
    b. frost free
    c. well-drained, etc.
2. self
3. by planting early, mid and late season varieties
4. June, one
5. registered, certified

6. matted row
7. so roots are covered and the crown is just at the soil level
8. a. prevent severe cold injury
   b. prevent heaving, keep berries clean
9. a. pick when fully ripe (red in color not white tipped)
   b. pick with stem and cap attached
   c. keep harvested berries from direct exposure to sun, etc.
10. process of narrowing matted row to stimulate formation of new runners; also contributes to weed control and soil fertility of the patch

UNIT - FRUIT AND VEGETABLE PRODUCTION

Lesson 7: Strawberries

## EVALUATION

1. List three desirable site characteristics for strawberry production.

   a.

   b.

   c.

2. Strawberry plants are ___________ fertile.

3. How does a strawberry grower spread out the harvest season?

4. ___________ bearing crops are grown by most commercial strawberry producers which produce ___________ crop(s) per year.

5. ___________ stock indicates plants free of virus, while ___________ stock indicates plants free from disease and insects.

6. Most Midwestern strawberry growers utilize the _________ planting system.

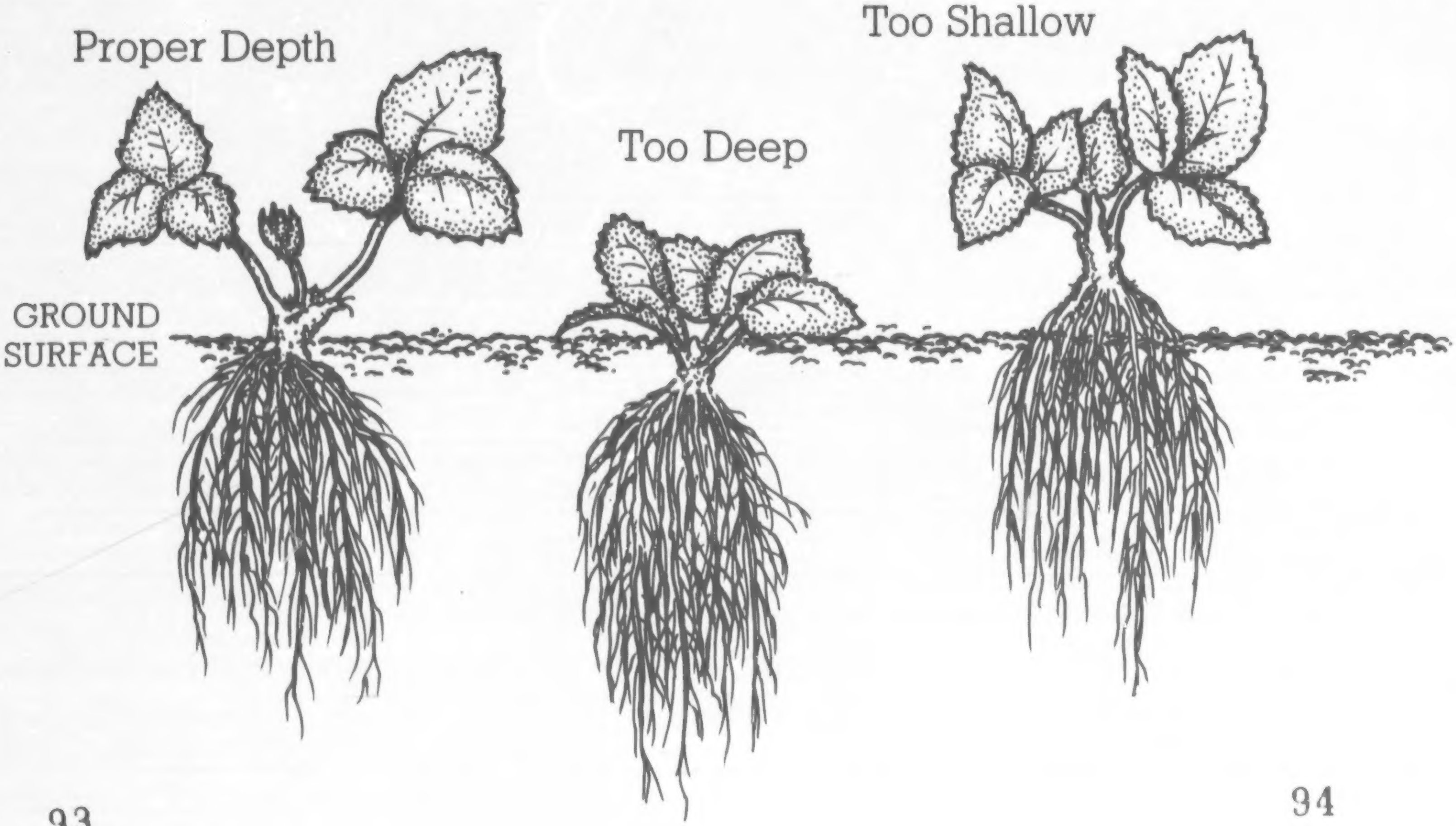
7. At what depth are strawberry plants set in the soil?

8. List two reasons for using a mulch on strawberries.

   a.

   b.

# Strawberry Planting Depths


Proper Depth
Too Deep
Too Shallow
GROUND
SURFACE

UNIT - FRUIT AND VEGETABLE PRODUCTION

Lesson 8: Brambles: Raspberries and Blackberries

Objective: The student will be able to identify characteristics of and techniques for growing raspberries and blackberries.

Study Questions:

1. Discuss the winter hardiness of blackberries and raspberries and list other factors that contribute to the success of bramble production.
2. Describe desirable soil and site qualities for producing bramble fruits.
3. Discuss the planting and pruning of blackberries and raspberries.
4. Why is irrigation important for bramble production? Describe the best system for irrigating.
5. List six ways to avoid pest problems in bramble fruit patches.

References:

1. Student Reference
2. Gardening for Food and Fun: USDA Yearbook of Agriculture, 1977, pp. 272-278.
3. Handout
    a) HO-22: Pruning Bramble Fruits
4. Transparency Master
    a) TM-22: Pruning Bramble Fruits

UNIT - FRUIT AND VEGETABLE PRODUCTION

Lesson 8: Brambles: Raspberries and Blackberries

TEACHING PROCEDURES

A. Review previous lesson

B. Motivation

Raspberries and blackberries have been rather scarce in local markets in recent years, yet there is a great demand for these fruits. As such they would be a good farm crop.

C. Assignment

D. Supervised Study

E. Discussion

1. List the degree of winter hardiness for raspberries and blackberries in view of local climatic factors. Discuss factors that contribute to plant hardiness or lack of hardiness. List and discuss other factors that can contribute to the success or failure of bramble patches. Take this opportunity to introduce students to the various types of raspberries and blackberries.

   **Discuss the winter hardiness of blackberries and raspberries and list other factors that contribute to the success of bramble production.**

   1) Raspberries
      a) Red raspberry is the hardiest with some varieties withstanding up to -35°F.
      b) Black and purple raspberries are next hardiest and may withstand -25°F.
   2) Blackberries
      a) Thorned blackberries withstand -15°F.
      b) Thornless blackberries are the least hardy and may be injured near 0°F.
   3) All these cane fruits can be injured at higher temperatures if growing conditions and cultural treatment were poor during the previous season.
   4) Other factors
      a) Select suitable varieties for your area; varieties differ greatly.
         (1) Quality of berry
         (2) Size of berry
         (3) Season of ripening
         (4) Hardiness
         (5) Disease susceptibility
      b) Growth and yield influenced by
         (1) Length of growing season
         (2) Temperature
         (3) Rainfall (irrigation)

        (4) Humidity
    5) Consult your county extension agent for information regarding suitable varieties.

2. Have student list desirable soil and site characteristics for bramble fruit production. Write these on the board.

    Describe desirable soil and site qualities for producing bramble fruits.

    1) Soil qualities
        a) Very good drainage - some brambles will not tolerate wet feet
        b) Clay to sand if drainage is good
            (1) Sandy loam with high organic matter content is best.
        c) Good water holding capacity
        d) pH 5.5 to 6.8
    2) Site qualities
        a) Perennial weeds eliminated
        b) Where solanaceous crops were not previously grown (verticillium wilt).
        c) Full sunlight

3. Elaborate on the establishment (emphasize spacing) and maintenance of bramble fruit crops. Discuss pruning procedures for raspberries and blackberries. You may want to have the class look at a catalog from a good nursery. Also emphasize the concepts of primocane and floricanes and the bramble growth and fruiting habits. (Use TM-22.)

    Discuss the planting and pruning of blackberries and raspberries.

    1) Order certified plants from a reliable nursery.
        a) Plants are usually sent in early spring.
        b) Store in a cool place or heel-in until you can set out.
    2) Prepare soil the season before planting.
    3) Spacing
        a) Raspberries and thorned blackberries - 30 inches between plants in the row
        b) Thornless blackberries - 5 to 8 feet between plants in the row
        c) 9 to 10 feet between rows is adequate (can be wider if necessary to accommodate machinery).
    4) Set plants 1 to 6 inches deeper than they were grown in the nursery.
        a) Red raspberry develops many suckers and is grown in a hedgerow - keep rows 6 to 18 inches wide.
        b) Purple and black raspberries develop few if any suckers and are grown in hills.
    5) Growth habits of bramble (canes are biennial while the roots are perennial)
        a) New canes (vegetative) are called primocanes.
            (1) These will flower the following growing season.
            (2) Primocanes are formed each season.

    b) Second season canes (previously primocanes) are called floricanes.
        (1) Buds on floricanes develop shoots with leaves that terminate with a flower.
        (2) Floricanes die after fruiting.

6) Pruning brambles
    a) Black and purple raspberries
        (1) Usually not trellised
        (2) Prune off tips of primocanes when they are 18 to 24 inches long (usually May or June).
            (a) Forces buds near the pruned tip to grow forming 3 to 7 foot laterals.
            (b) The following winter prune laterals back to 8 inches from the main cane.
    b) Red raspberries
        (1) May be trellised and confined to narrow rows
        (2) Pruned in late winter
            (a) Remove old fruiting cane and weak or damaged canes.
            (b) Leave 2 to 4 canes per foot of row and secure to trellis.
        (3) Hedgerow system
            (a) Trellis is usually not used.
            (b) Rows are kept at 18 to 24 inches.
            (c) Fruiting canes are pruned to a height of 36 to 24 inches.
    c) Thornless blackberries
        (1) Usually trellised
        (2) Allow primocanes to grow along the ground.
        (3) Tie floricanes individually to trellis wires.
        (4) Remove old floricanes (ones that have fruited).

4. Ask students to discuss the importance of irrigation to brambles and the pros and cons of various systems. Emphasize the trickle system and, if possible, show the class the plastic components of the trickle tubes.

**Why is irrigation important for bramble production and describe the best system for irrigating?**

1) Cane fruits respond to timely applications of water.
    a) Important during bloom periods
    b) Also important from May to September for adequate growth and development of primocanes
2) Trickle irrigation is the best method of irrigating.
    a) Applies only a few gallons of water daily
    b) Requires very little water at a very low pressure
    c) Does not wet the entire surface
    d) Overhead sprinklers wet foliage and encourage foliar diseases

5. List the various pest problems of bramble fruits. Note that insect and disease problems are minimal (leaf diseases are the biggest problem) and that it is possible to grow these fruits with very little pesticide usage. List steps one can take to minimize these pest problems, and explain the value of each measure.

   List six ways to avoid pest problems in bramble fruit patches.

   1) Plant only quality stock.
   2) Keep plants well-spaced with narrow rows in full sunlight.
   3) Use light applications of nitrogen fertilizers.
   4) Remove diseased and sick plants and all canes that have fruited.
   5) Allow birds to live near the garden because they eat insect pests.
   6) Replant with quality stock every 5 to 7 years.

F. Other Activities

1. Visit a local bramble farm and observe the seasonal activities.

G. Competency

Identify characteristics of and techniques for growing selected bramble fruits.

H. Answers to Evaluation

1. red raspberry, purple and black raspberries, thorned blackberries, thornless blackberries
2. True
3. a. very well-drained
   b. full sunlight
   c. pH slightly acid, etc.
4. Bramble plants have perennial roots and biennial shoots. Primocanes are the first season's vegetative growth. These then overwinter and flower the following year and are then called floricanes. New primocanes are developed each year.
5. It wets the foliage and encourages foliar diseases.

UNIT - FRUIT AND VEGETABLE PRODUCTION

Lesson 8: Brambles: Raspberries and Blackberries

## EVALUATION

1. Rank the types of raspberries and blackberries from hardiest to least hardy.

2. True or False (circle one): Proper cultural treatment and growing conditions during the growing season will enable brambles to withstand colder winter temperatures.

3. List 3 desirable soil and/or site characteristics from bramble production.

   a.

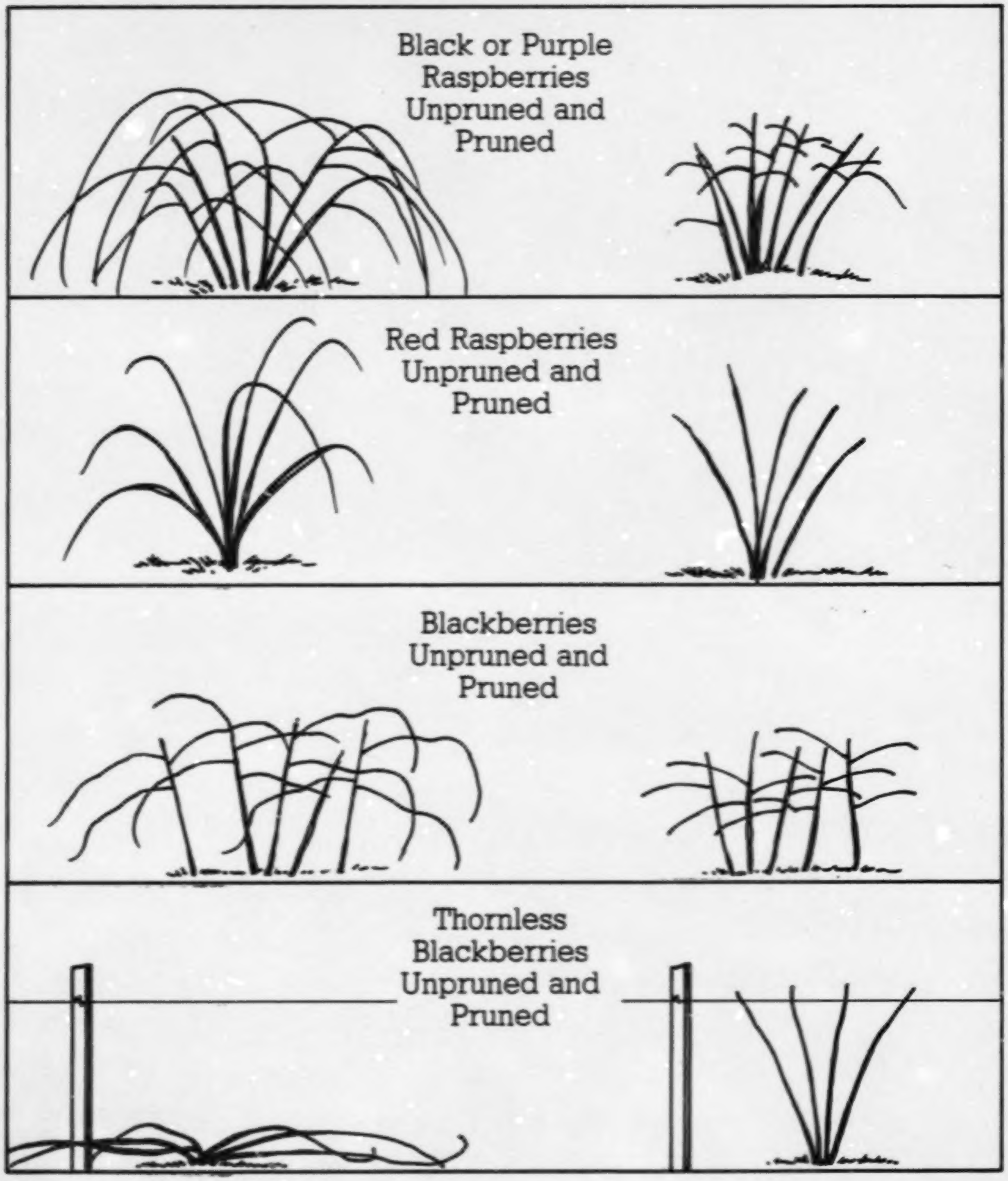
   b.

   c.

4. Describe the growth and fruiting habit of brambles.

5. Why is overhead irrigation undesirable in a bramble planting?

# Pruning Bramble Fruits


Black or Purple Raspberries Unpruned and Pruned
Red Raspberries Unpruned and Pruned
Blackberries Unpruned and Pruned
Thornless Blackberries Unpruned and Pruned

UNIT - FRUIT AND VEGETABLE PRODUCTION

Lesson 9: Blueberries

Objective: The student will be able to identify characteristics of and techniques for cultivating hybrid blueberries

Study Questions:

1. Name the two types of cultivated hybrid blueberries and describe the environmental characteristics conducive to their cultivation.
2. Outline the steps in setting out blueberry plants.
3. How can you adjust the pH of your soil to suit blueberry plants?
4. Discuss the importance of irrigation to blueberry cultivation.
5. How are blueberry plants pruned?
6. When are blueberries harvested?

References:

1. Student Reference
2. Gardening for Food and Fun: USDA Yearbook of Agriculture, 1977, pp. 279-283.
3. Handout

   HO-23: Pruning Blueberry Plants
4. Transparency Master

   TM-23: Pruning Blueberry Plants

UNIT - FRUIT AND VEGETABLE PRODUCTION

Lesson 9: Blueberries

TEACHING PROCEDURES

A. Review previous lesson

B. Motivation

Blueberries are called aricaceous or "acid-loving" plants. The potential for blueberry production in Mid-western states is just now being realized. Fresh market production opportunities are great.

C. Assignment

D. Supervised Study

E. Discussion

1. Describe the two types of hybrid blueberries commercially cultivated. Discuss the climatic and cultural requirements peculiar to heath family plants.

   **Name the two types of cultivated hybrid blueberries and describe the environmental characteristics conducive to their cultivation.**

   1) Types of cultivated hybrid blueberries
      a) Highbush blueberry
      b) Rabbit-eye blueberry
   2) Cultivation of blueberries
      a) Both have a mass of delicate, fibercus root hairs confined to the upper 8 to 10 inches of soil.
         (1) Not a good competitor
         (2) Needs open porous soils with a high water table
      b) Both grow best in acid soils (pH 3.5 to 5.0 with 4.5 about optimum)
      c) High organic matter for increased acidity, porosity, drainage and tilth
      d) Plants vary in height up to 8 feet tall.
      e) Spread by rhizomes
      f) Fruit is born on perennial stems (canes).
      g) Plant in full sunlight.
      h) Free air movement is necessary to prevent late spring frosts from killing flower buds (avoid low-lying areas and frost pockets).
      i) Plant highbush berries in areas having 160 or more frost free days and 800-1200 hours below 45°F in the winter.
      j) Rabbit-eye varieties need only 400-600 hours of less than 45°F winter temperatures.

2. Have students describe the steps involved in setting out a blueberry patch. Emphasize spacing, pollination, transplanting and mulching.

**Outline the steps in setting out blueberry plants.**

1) Spacing
   a) Highbush - 4 to 5 feet apart in rows 8 to 10 feet apart
   b) Rabbit-eye - 5 to 6 feet apart in rows 10 to 12 feet apart
2) Pollination
   a) Highbush is self-fruitful but, for best fruit set with larger berries which ripen faster and more uniformly, provide additional varieties for cross-pollination.
   b) Rabbit-eye requires cross pollination to set fruit.
   c) Consult your county extension agent for recommended varieties.
3) Transplanting
   a) Order certified stock.
   b) Two-year-old plants offer best transplant survival rates.
   c) Prune plants to 3 or 4 strong shoots spaced around the crown (either before or after planting).
      (1) Prune back the remaining shoots to remove the plump, round fruit buds.
      (2) Cut just above a narrow, pointed vegetative bud.
   d) Dig a hole 12 to 18 inches deep and 18 inches wide.
   e) Plants should be set 1 to 2 inches deeper than grown in nursery.
   f) Mix soil taken from hole before replacing.
   g) Firmly press soil around the plant with your feet.
   h) Water in plants.
4) Mulch plants with sawdust, 6 inches deep and 36 inches wide.

3. Discuss with students the use of micro-fine sulfur application for acidifying soils. This may be applied before planting and as maintenance applications thereafter.

**How can you adjust the pH of your soil to suit blueberry plants?**

1) Incorporate microfine sulfur (commercially available from local fertilizer dealers).
   a) Add 1 to 3 pounds per 100 square feet.
   b) Work sulfur in.
2) Addition of organic matter also aids in acidifying soils.

4. Ask students to discuss the importance of and techniques for irrigating blueberries.

**Discuss the importance of irrigation to blueberry cultivation.**

1) Young plants (particularly the first year after setting out) are very sensitive to drying out.
   a) One inch of water per week during the growing season is essential for maximum growth and fruiting.
   b) Water is critical just after setting out and through the first two growing seasons.

        c) Supply water from an open hose, sprinklers or surface irigation.

5. Describe techniques for pruning blueberry bushes. (Use TM-23.)

**How are blueberry plants pruned?**

1) Blueberry plants should be pruned annually during the dormant season.
    a) Lengthens bush life
    b) Produces strong, new growth
    c) Space bearing wood for optimum light distribution and increasing berry size.
    d) Starting the third growing season, remove old canes that are weak or shaded.
        (1) Cut back very vigorous, upright shoots to promote branching.
        (2) Remove short, weak shoots.
        (3) Tip back long shoots to 6 to 8 inches.
        (4) Reduce heavily branched canes by a third.
    e) Select several renewal shoots.
        (1) From ground - cut back to 8-12 inches
        (2) From old canes - cut back to 4-6 inches

6. Discuss the timing of blueberry harvest and how they are picked.

**When are blueberries harvested?**

1) Harvest weekly (or twice weekly).
2) Pick only fully colored, deep blue berries.
3) Use thumb to roll berries into your hand.
    a) Do not pinch the berries.
    b) If the berries do not easily roll off, they are not quite ready for harvest.

F. Other activities

G. Competency

Identify characteristics of and techniques for cultivating highbush and rabbit-eye blueberries.

H. Answers to Evaluation

1. acid-loving, 3.5 to 5.0
2. Two
3. a. porous, good tilth
    b. well-drained, good water-holding capacity
    c. high organic matter
4. applications of micro-fine sulfur and addition of organic matter
5. Watering is critical after setting out plants and during the first two growing seasons. Blueberry plants are very susceptible to drought injury. Water may be applied by open hose, sprinklers or surface irrigation.

UNIT - FRUIT AND VEGETABLE PRODUCTION

Lesson 9: Blueberries

## EVALUATION

1. Blueberries are known as ___________ ___________ plants and prefer a soil pH of about ___________.

2. ___________-year-old blueberries offer the best transplant survival.

3. List 3 soil characteristics preferred for blueberry cultivation.

   a.

   b.

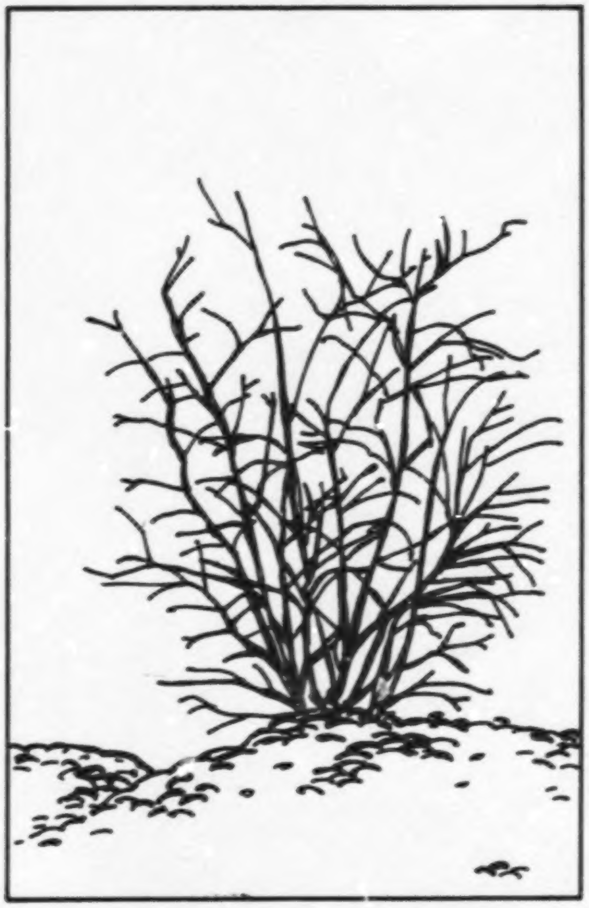
   c.

4. How can soil pH be lowered to levels needed for blueberry production?

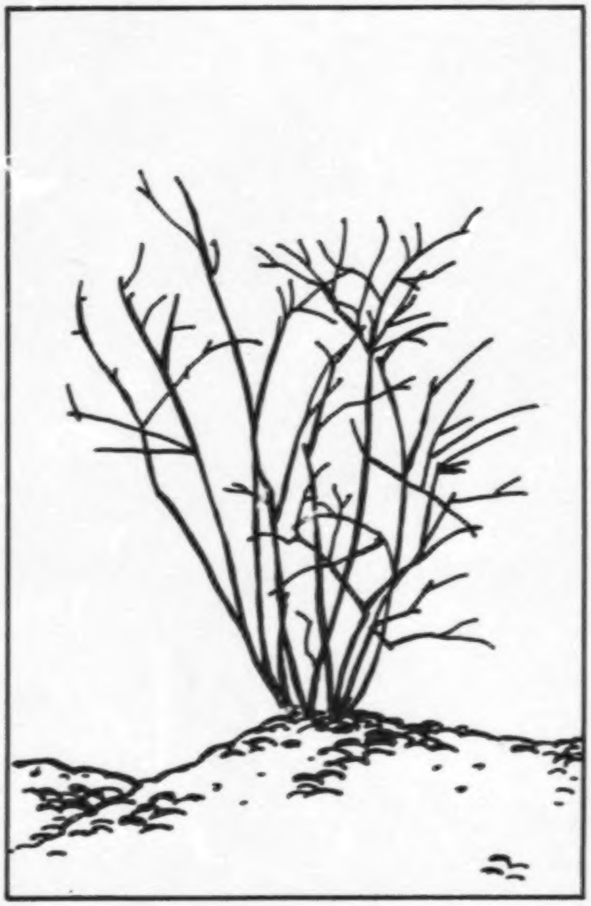
5. Discuss irrigation needs for blueberry plantings.

TM-23

# Pruning Blueberry Plants



Blueberry Plant
Before Pruning



Same Plant
After Pruning

UNIT - FRUIT AND VEGETABLE PRODUCTION

Lesson 10: Grapes and Vineyards

Objective: The student will be able to identify characteristics of and techniques for growing grapes.

Study Questions:

1. List six basic requirements for successful grape production.
2. Name the three types of grapes grown and indicate which type is most suitable for Midwestern regions and why.
3. Describe how to set out grape plants and list general considerations for building grapevine support structures.
4. Discuss general aspects of grapevine pruning and cluster thinning.
5. How do you know when grapes are sufficiently ripe for harvest?

References:

1. Student Reference
2. Gardening for Food and Fun: USDA Yearbook of Agriculture,1977, pp. 260-264.
3. Missouri Cooperative Extension Service Agricultural Guides
    a) G06161: Pruning and Training Vineyards
    b) G06162: Training Systems for Missouri Vineyards
    c) G06160: Establishing a Vineyard in Missouri

4) Handouts
    a) HO-24: Trellis Systems for Grapes
    b) HO-25: Pruning Young and Mature Grapevines

UNIT - FRUIT AND VEGETABLE PRODUCTION

Lesson 10: Grapes and Vineyards

TEACHING PROCEDURES

A. Review previous lesson.

B. Motivation

There is quite a potential for fresh market table grapes and for contract grape production for processors. Also in recent years, there has been renewed interest in Missouri's wine grape industry.

C. Assignment

D. Supervised Study

E. Discussion

1. List the six basic requirements for grape production on the board. Elaborate on each and relate them to your local environment.

   **List six basic requirements for successful grape production.**

   1) A growing season of at least 140 frost-free days
   2) A site with full sunshine and good air drainage (not frosty)
   3) Soils that are neither waterlogged nor shallow, at least 3 feet deep
   4) Willingness to spray for pest control
   5) Patience to wait three to four years for vines to reach maturity before cropping
   6) Annual pruning of vines

2. List the three types of cultivated grapes and discuss their uses and the major regions of production in the U.S. This would be a good time to elaborate on Missouri's grape and wine industry.

   **Name the three types of grapes grown and indicate which type is most suitable for Midwestern regions and why.**

   1) Old World types (vinifera)
      a) Grown in California and some Southwest regions
      b) Used for wine and table
   2) Muscadines
      a) Grown in southern regions
      b) Used for wine and table
   3) American and French-American
      a) Grown in humid regions
      b) Tolerant of diseases and insects
      c) Used for Midwest regions
      d) Grown for wine, table, and processing

3. Discuss practices involved in setting out grape plants. Include pruning of the new vines. This would be a good time to discuss trellis systems. For more detailed information, see Missouri Cooperative Extension Service Agricultural Guides, G06161, G06162 and G06160. (Use TM-24.)

**Describe how to set out grape plants and list general considerations for building grapevine support structures.**

1) Plant vines in the spring.
2) Plant vines at about the same height they were grown in the nursery.
    a) Make sure graft unions are 2 inches above soil level.
    b) Spread roots out in the hole, trimming roots if necessary.
3) Cut top back to 2 or 3 buds.
4) After these buds break and new shoots begin to grow, remove all but the most vigorous and straight shoot.
    a) Drop a string from the trellis wire to the shoot so that the shoot will grow straight to the top trellis wire.
    b) During the course of the first growing season, remove all laterals to allow the main trunk to grow rapidly and reach the top.
    c) When the main shoot reaches the top of the trellis, pinch out the terminal bud to encourage laterals to develop at trellis wires.
5) Support systems
    a) 4 cane kniffen
    b) Geneva double curtain
6) General considerations for support systems
    a) Bracing
    b) Set posts no more than 20 feet apart.
    c) Use 11- or 12-gauge smooth galvanized wire.
    d) Lowest wire should be 30 to 36 inches above the ground.

4. Illustrate pruning objectives for the various training systems. Agricultural Guides G06160, G06161, and G06162 would provide a detailed explanation of grape pruning if greater depth is desired. Discuss the purpose and method of cluster thinning. (Use TM-25.)

**Discuss general aspects of grape vine pruning and cluster thinning.**

1) Pruning is conducted during the dormant season.
    a) Fruiting canes are trained outward along trellis wires.
        (1) Fruiting canes are one-year-old shoots.
        (2) Their bark is smooth and brown.
    b) Portions of or whole fruiting canes are removed.
        (1) Fruiting canes have leaf scars and buds; these buds will grow into shoots and produce grape clusters (usually three) the following growing season.

        (2) Pruning to remove fruiting wood controls fruit set (controls number of buds).

    2) Cluster thinning is conducted to remove additional excess grape bunches to balance the fruit load. (Remove excess clusters from bloom until mid-season.)

5. Discuss how to tell when grapes are ready for harvest in respect to their intended use.

   **How do you know when grapes are sufficiently ripe for harvest?**

   1) Table use
      a) Good flavor
      b) Blue grapes lose their red color.
      c) White grapes change from green to golden yellow.
      d) Ripe berries will soften and seeds become brown.
   2) Wine use
      a) Experience
      b) Acid and sugar levels measured with special instruments

F. Other Activities

1. Visit a local vineyard to observe the seasonal labors.

G. Competency

Identify characteristics of and basic techniques for growing grapes.

H. Answers to Evaluation

1. a
2. American or French-American hybrids
3. to develop a main stem that reaches the top of the trellis
4. current
5. trellis

UNIT - FRUIT AND VEGETABLE PRODUCTION

Lesson 10: Grapes and Vineyards

## EVALUATION

1. Which is not a basic requirement for successful grape production?

   a. site with full sunshine
   b. soils that are relatively shallow
   c. soils that are not waterlogged
   d. sites with good air drainage

2. What type of grape is generally best suited for Midwestern growing conditions?

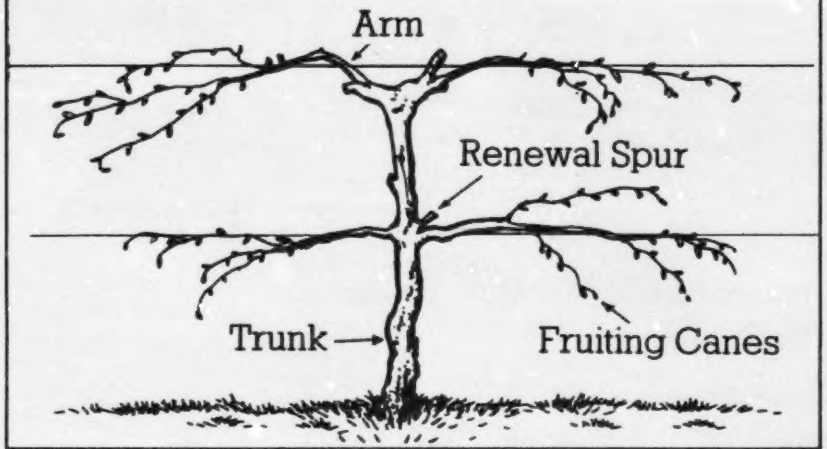
3. What is the grower's objective for the newly set grape plant's first season of growth?

4. Fruit canes of grapes are ____________ season's growth.

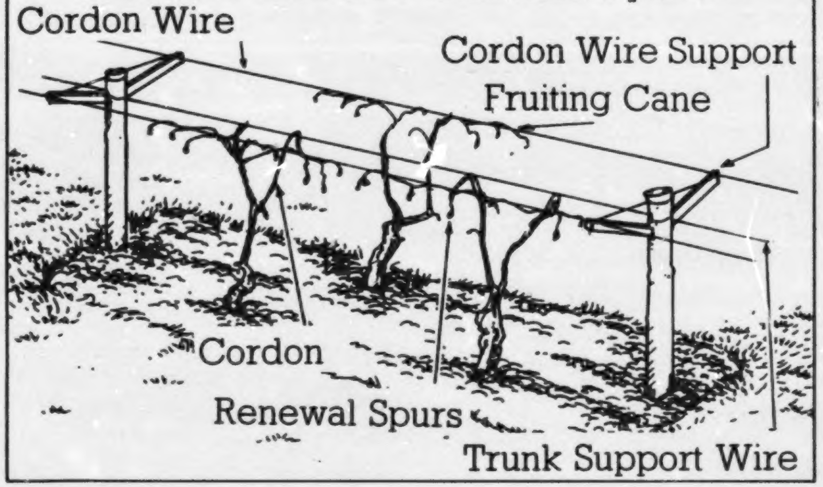
5. Removal of some of the fruit load on a given vine during the growing season is called ____________.

# Trellis Systems for Grapes

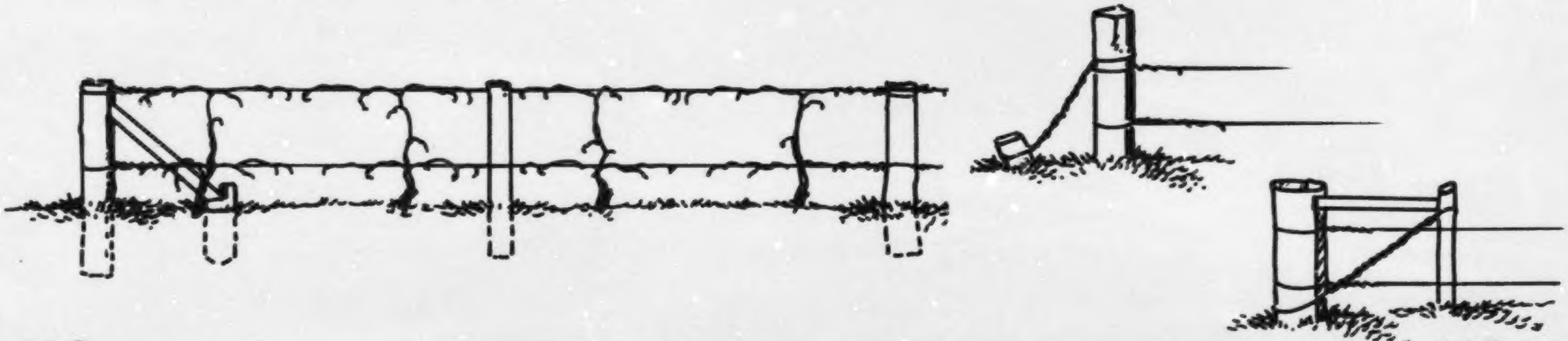
## Kniffen System


Arm
Renewal Spur
Trunk
Fruiting Canes

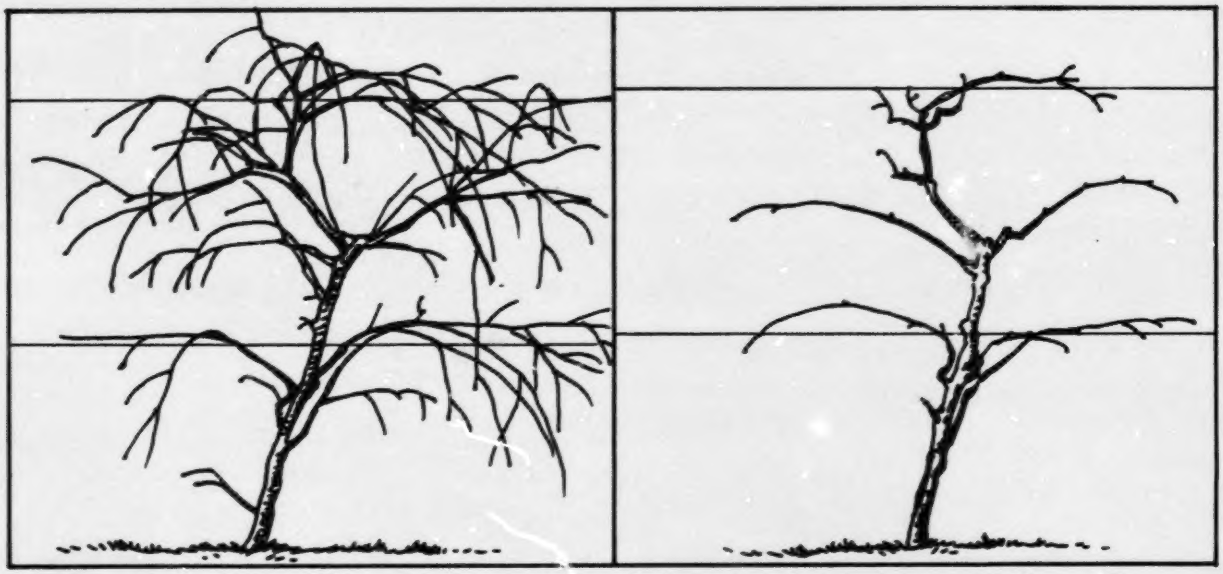
## Geneva Double Curtain System


Cordon Wire
Cordon Wire Support
Fruiting Cane
Cordon
Renewal Spurs
Trunk Support Wire

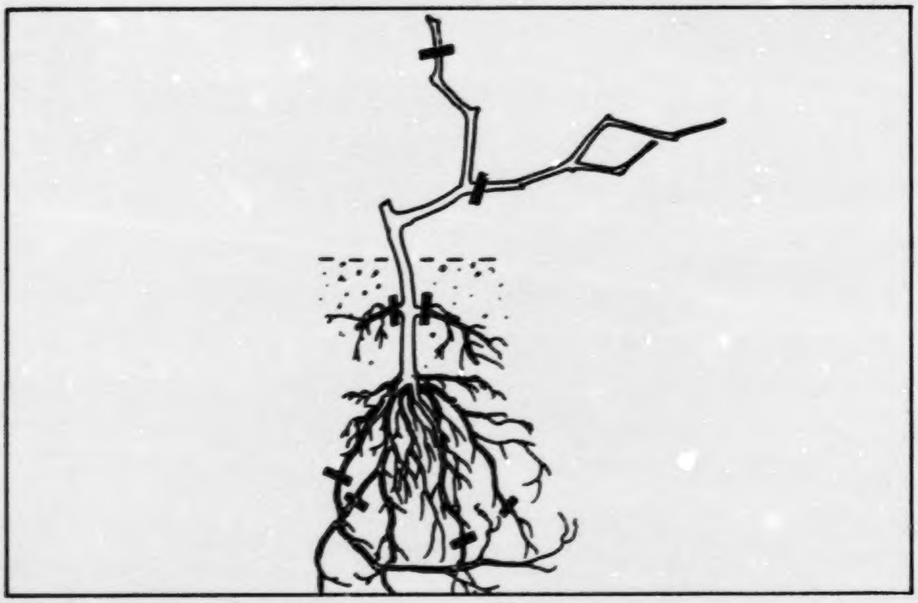
## Details of Two-wire Trellis with Alternative End Post Bracing



# Pruning Young and Mature Grape Vines



"Balanced pruning" on a six-cane kniffen-trained Concord Vine. Vine was pruned by the "30 plus 10" formula (leave 30 buds for first pound of one-year wood removed plus 10 buds for each additional pound of wood removed).



Before planting a rooted grape cutting, the tops and roots are pruned as indicated.

UNIT - FRUIT AND VEGETABLE PRODUCTION

Lesson 11: Marketing Fresh Fruits and Vegetables

Objective: The student will be able to identify several alternatives for small and part-time farmers to direct market their fresh fruit and vegetable crops.

Study Questions:

1. **Why should a marketing plan be developed before starting a fruit or vegetable enterprise?**
2. **Describe four different types of direct marketing of fresh fruits and vegetables.**
3. **Describe the attitude a producer should have when presenting and selling his produce to consumers.**

References:

1. Student Reference
2. Manual #75: Missouri Farm Planning Handbook.
3. Missouri Cooperative Extension Agricultural Guide G00260: Starting a Successful Farmers' Market

UNIT - FRUIT AND VEGETABLE PRODUCTION

Lesson 11: Marketing Fresh Fruits and Vegetables

TEACHING PROCEDURES

A. Review previous lesson

B. Motivation

There are many opportunities for small part-time and diversified farmers in the production and direct marketing of fruits and vegetables. It takes minimal capital to get started and the financial rewards can be plentiful.

C. Assignment

D. Supervised Study

E. Discussion

1. Ask the students why they think it would be important to have a marketing plan ready for a fruit or vegetable crop. List these reasons on the board. Emphasize the perishability of these crops and the fact that when they are ready to harvest it can't be postponed.

   **Why should a marketing plan be developed before starting a fruit or vegetable enterprise?**

   1) No money can be made if you can't sell the crop.
   2) Fruits and vegetables must be harvested on time and moved quickly.
      a) Highly perishable
      b) Cannot afford to take the risk

2. Ask the students to describe the different types of fresh marketing fruits and vegetables. Have them explain how each might work and why they would use certain types in their marketing plans. Use local examples. (See manual #75 and Missouri Cooperative Extension Agricultural Guide G00260.)

   **Describe four different types of direct marketing of fresh fruits and vegetables.**

   1) Farmers' markets
   2) Roadside marketing
   3) Pick-your-own farms (Good way for young farmers to get into business because it requires minimal labor and investment)
   4) Supplying retailers

3. Discuss with the class the virtues of honesty and fairness in business. Stress that when selling fresh fruits and vegetables, quality is of the utmost importance. Note that consumers are more than willing to pay the price to get quality produce and the only way to develop a clientele is to sell only quality produce at a fair price. Show Manual 75 to the class and discuss production budgets and establishing a good price for ones produced.

   Describe the attitude a producer should have when presenting and selling his produce to consumers.

   1) Honesty - don't misrepresent your product
   2) Sell only high quality produce.
      a) Even 2nd grade produce should be high quality.
      b) Grade produce and price it according to its grade.
   3) Price produce fairly.
      a) Determine the price that will provide a suitable return and at the same time be supported by local demand.
      b) For example, early tomatoes command a healthy price, but later in the season it is difficult to make profits on them.

F. Other Activities

1. Develop budgets using Manual 75 for several different crops.

2. Visit different direct markets of fresh fruits and vegetables in your area.

G. Competency

1. To identify approaches and ideas for the direct marketing of fresh fruits and vegetables

H. Answers to the Evaluation

1. marketing
2. Any 3 of these:
   a. roadside market
   b. farmers' market
   c. U-pick supplying retailers
   d. supplying retailers
3. It keeps labor costs to a minimum and it is a good way for young farmers to get into the business because it requires minimal investment.
4. quality

UNIT - FRUIT AND VEGETABLE PRODUCTION

Lesson 11: Marketing Fresh Fruits and Vegetables

## EVALUATION

1. Before undertaking the production of fruits or vegetables, the grower should develop a ____________ plan.

2. List three different kinds of direct marketing for fresh produce.

   a.

   b.

   c.

3. What is the advantage of having customers harvest their produce?

4. The first rule for marketing fresh fruits and vegetables is to sell only good ____________ produce.